MECHANICAL ENGINEERING

August, 1958

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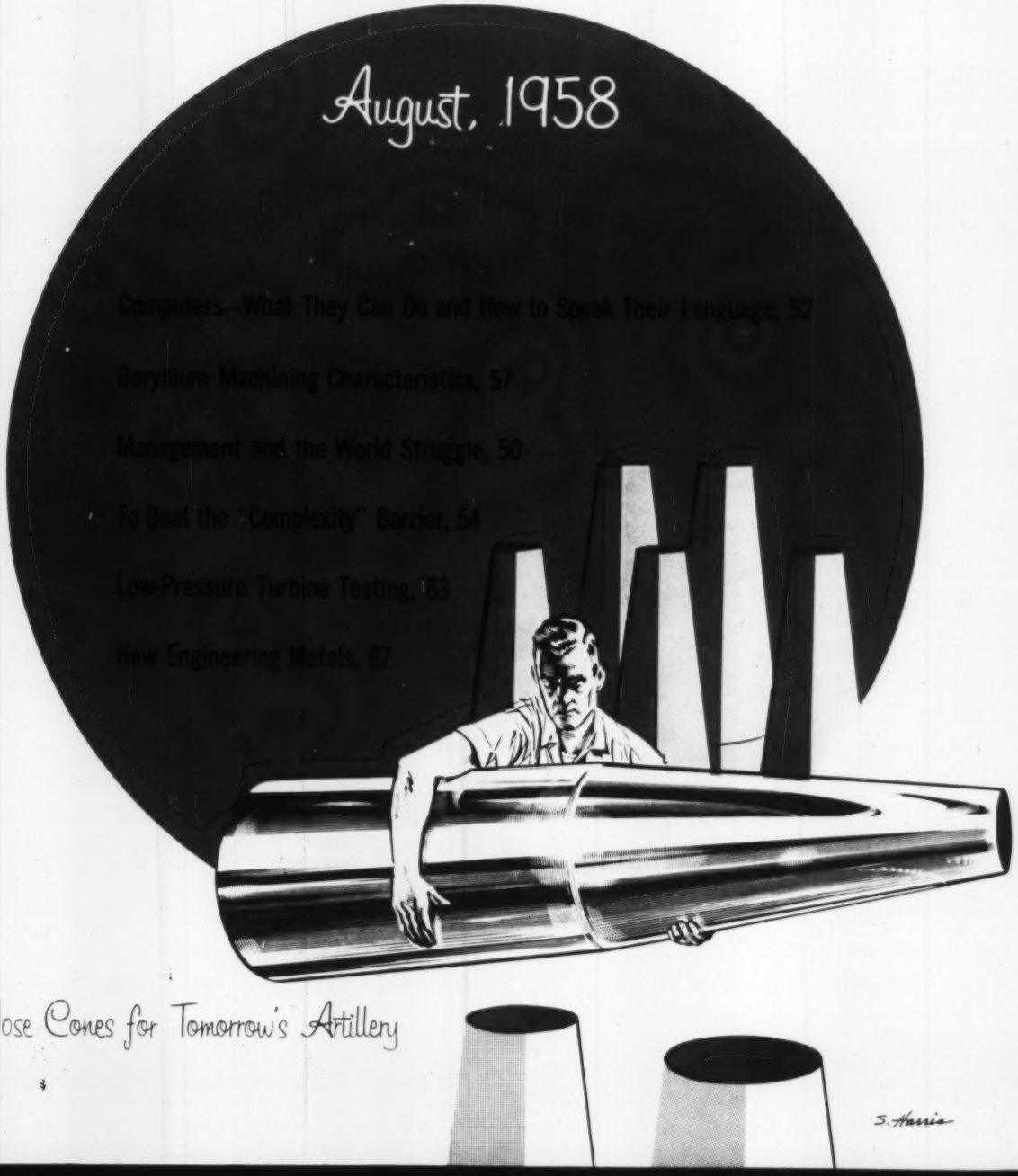
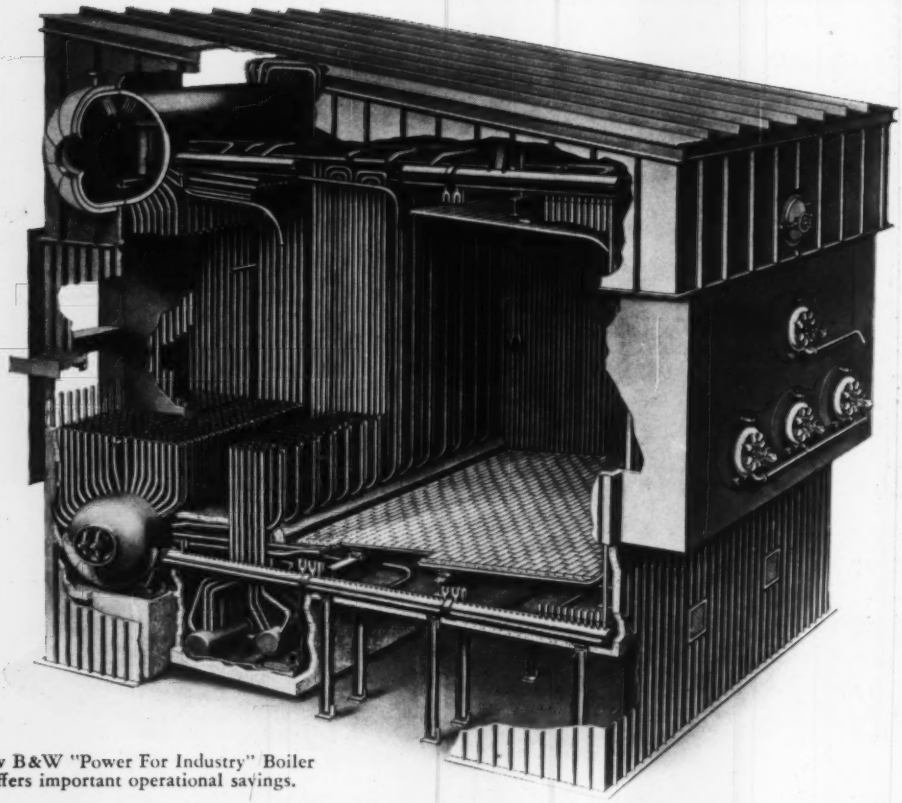


Nose Cones for Tomorrow's Artillery

S. Harris



New B&W "Power For Industry" Boiler offers important operational savings.

New Economical Power For Industry

B&W "PFI" Oil-Gas Burning Boiler Provides Maximum Output in Minimum Space

Here's an answer to industry's need for an economical, dependable steam supply. The new B&W Integral-Furnace Boiler produces high-quality, dependable steam economically at all ratings. Aptly named the PFI, the "Power For Industry" Boiler is compact, easy to install, quick to meet rapid and wide load swings. The new boiler gives long, sustained operation, requires little attention and is readily accessible for inspection, cleaning and maintenance.

Here are eight ways in which the PFI Boiler can be of benefit to you:

1. It requires a minimum amount of space for a given power output.
2. The pressurized furnace design assures economy by eliminating the induced draft fan and air infiltration. This means savings in cost of fans, fuel, and operating power.
3. Pre-assembly of many of the components of the PFI Boiler is controlled in B&W shops, resulting in a reduction of the time and manpower required for field erection.
4. The PFI is designed to burn oil, gas, or a combination of the two. When it is equipped with a dual-fuel burner, it allows you to take advantage of favorable market conditions.
5. Cyclone Steam Separators insure adequate water circulation which protects boiler tubes from overheating, even with wide and frequent changes in load. They also give you clean, dry steam at all designed ratings with high boiler water concentrations.
6. The drainable superheater design assures quick, safe start-up and ease of storage.
7. Water-Cooled Burner Throat eliminates troublesome maintenance, costly repairs.
8. All-Welded Membrane Wall contributes to high efficiency and reduces insulation requirements.

B&W has placed over 4,000 Integral-Furnace Boilers of various types in service over the past 25 years alone. This experience is your assurance of quality. For further information, write for Bulletin G-94. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

G-892A-1F

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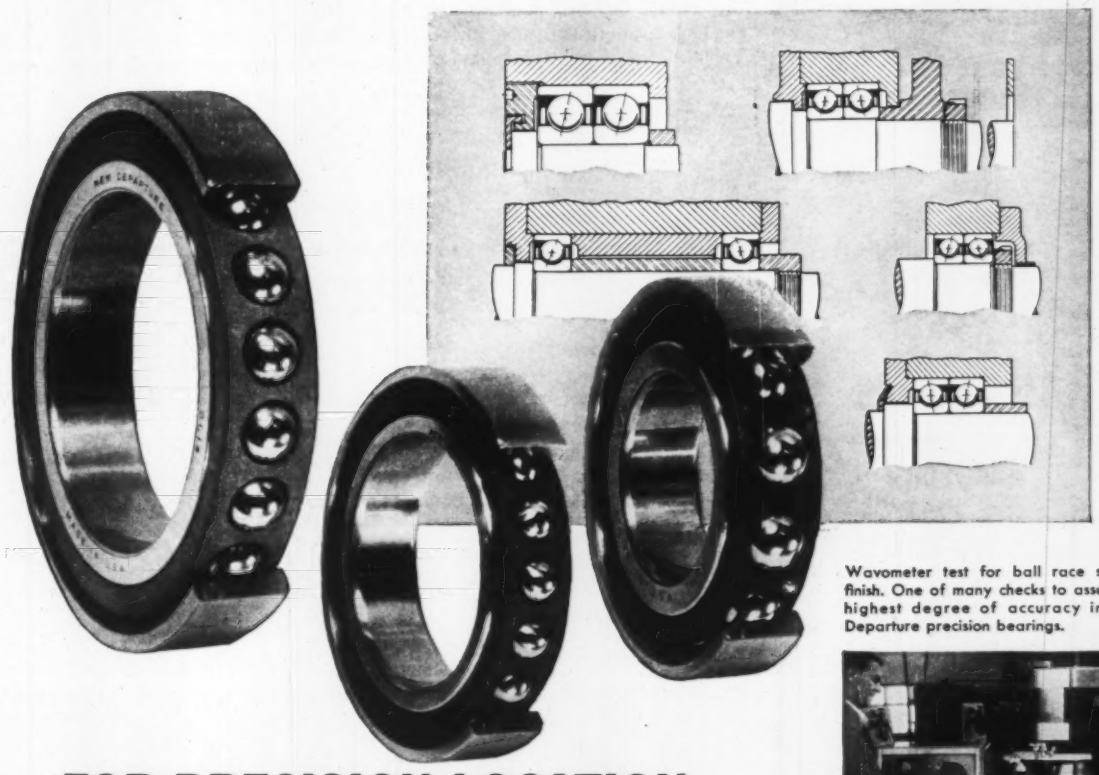
BOILER DIVISION

ND FACTS



Wavometer test for ball race surface finish. One of many checks to assure the highest degree of accuracy in New Departure precision bearings.

Checking bearing face flushness under axial loads.

FOR PRECISION LOCATION... PLUS WIDE ADAPTABILITY

NEW DEPARTURE BALL BEARINGS

New Departure angular contact ball bearings are available in a full range of Extra-Light, Light and Medium Series, to all precision specifications. They give the designer a wide variety of bore, outside diameter and width relationships and mounting methods.

Made to light, medium and heavy preloads, and ground for universal mounting in any of the duplex arrangements or separated by spacers of equal length, they assure exact location of shafts or spindles under load conditions of every kind.

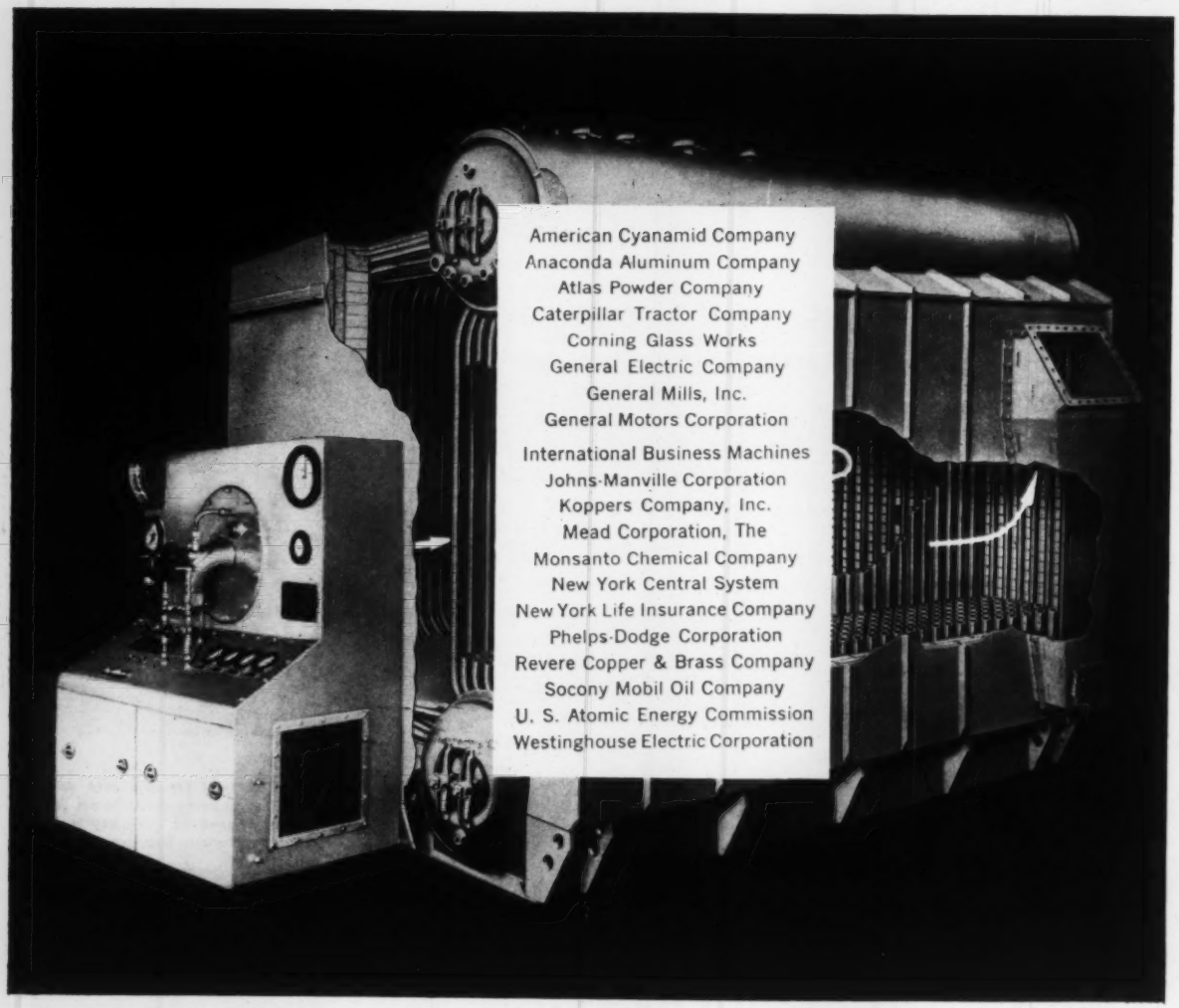
For full information, send for free booklets BA and DD on design and application.

1908–1958 GM FORWARD FROM FIFTY

NEW DEPARTURE

DIVISION OF GENERAL MOTORS, BRISTOL, CONN.

NOTHING ROLLS LIKE A BALL



LEADING INDUSTRIALS CHOOSE THE VP

Not only do many of the nation's leading industrial companies – such as those listed above – buy VP Boilers, but also a long list of smaller companies and institutions have VP package boiler installations.

The choice of the "big" companies, however, has some special significance. They buy boilers frequently – therefore, their experience is always up to date. They buy them in all capacities large and small. Their requirements justify employment of highly qualified engineering specialists – both staff men and outside consultants. Thus, they have the breadth of experience and the expert guidance requisite to making the soundest equipment selections.

So – if you are in the market for boilers in the capacity range from 4,000 to 50,000 pounds of steam per hour, we submit that you can buy with confidence the boiler chosen by so many of the nation's largest industrialists – the C-E Package Boiler, Type VP. A new descriptive catalog, VP-3, is just off the press. Write for your copy.

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ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

MECHANICAL ENGINEERING

PUBLISHED BY
THE AMERICAN SOCIETY OF
MECHANICAL ENGINEERS

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THE COVER

Nose cone for a guided missile. You'll be hearing about the Lacrosse, a close and general support weapon for the Army and Marine Corps, built by the Martin Company, at Orlando, Fla. Solar Aircraft Company, in San Diego, Calif., makes this nose cone of high-alloy steel, employing unique welding techniques for which Solar designed the equipment. Beyond that, the engineering is classified. The Lacrosse, with area-type warhead and solid-propellant motor, will replace and supplement conventional artillery.

MANAGEMENT AND THE WORLD STRUGGLE..... F. R. Barnett 50

It's later than we think. American business is drowsing, inviting an economic Pearl Harbor. So states this report to the Power Conference, briefing engineers on the nature of the enemy.

COMPUTERS—What They Can Do and How To Speak Their Language.....V. Paschkis 52

Don't expect them to create. They can't think. They're merely tools, albeit fabulous ones. Without them, no automation. Here is a clarifying statement on their functions and "language."

TO BEAT THE "COMPLEXITY" BARRIER.....J. de S. Coutinho 54

How do you design a safe airplane? A sound structure, yes: But then you must specify complex component systems. At Grumman, a filing system delivers complete information to the designers.

BERYLLIUM MACHINING CHARACTERISTICS .....D. R. Walker 57

It has such a high elastic modulus, such a high strength-weight ratio. It is also brittle . . . and toxic. An Avco engineer reports this wonder metal's behavior under the cutting tool.

LOW-PRESSURE TURBINE TESTING.....J. E. Downs and K. C. Cotton 63

Trouble was, they couldn't determine the efficiency of a turbine's l-p sections—not close enough to evaluate modifications. At GE, they've built a full-scale l-p test facility. Here it is.

NEW ENGINEERING METALS.....J. P. Denny and L. F. Kendall, Jr. 67

Things get tougher for the designer. His machines and components must endure heat and corrosive influence never before encountered. What does he do? He brings up new engineering materials.

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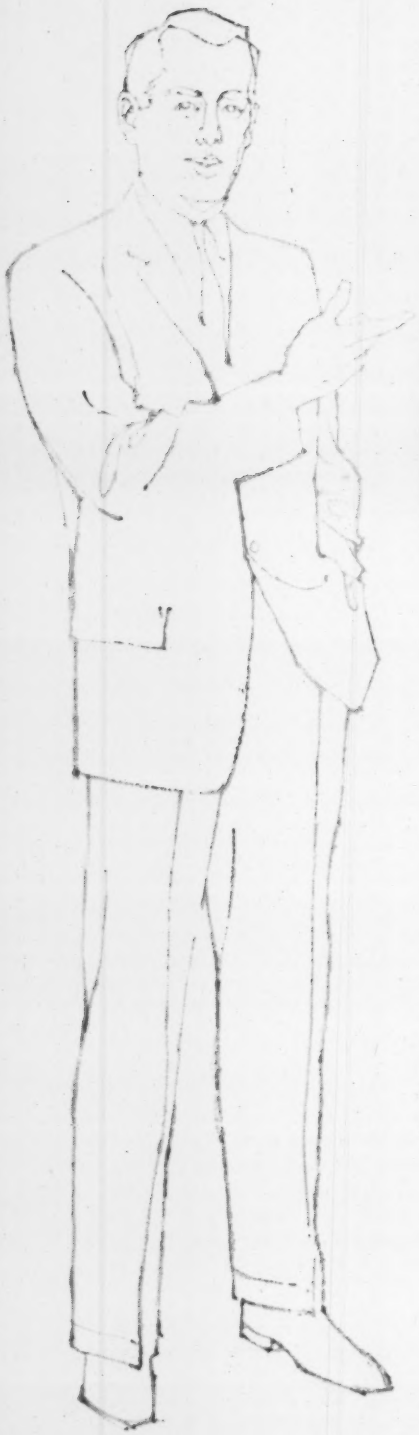

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"Minimum installation time and costs are my responsibility. The dimensional accuracy of B&W Welding Fittings permits quick and positive welding with no erection delays."

Cutting costs is everyone's responsibility. In a piping system, using welding fittings that align accurately is one sure way of saving time and money — in installation and in maintenance. The dimensional accuracy of welding fittings like this B&W Ell assures you of trouble-free fabrication and installation. Their true circularity, full radius, and walls of uniform thickness will enable you to make your piping dollars go farther. Write for bulletin FB504.

B&W Welding Fittings and Forged Steel Flanges are available in carbon steel and the B&W CROLOYS.

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PUBLISHED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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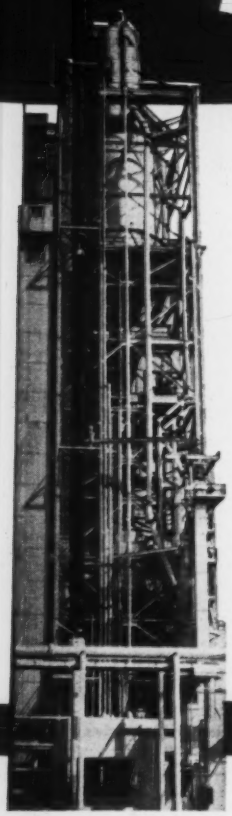
41 Modern Refineries



Catalyst erosion of lift pipes and catalyst handling lines no longer is a problem with refineries listed below. All have eliminated a costly maintenance bottleneck and speeded up turnaround operations by using "Dual Metal."

In making a "Dual Metal" lift pipe the outer shell of weldable alloy steel is poured into a rapidly rotating mold. At the proper time and temperature the abrasion-resistant alloy iron core is introduced. The metallurgically bonded two metal structure combines the strength and weldability of low alloy steel with the superior abrasion resistance of alloy iron.

In one typical refinery, "Dual Metal" high temperature catalyst pipe showed an abrasion resistance of better than 16 to 1 over conventional steel piping.

"Dual Metal" may be the answer to *your* abrasion problem. Write today for literature and information on the increasingly important part this time and money saving process is playing in the refining industry.

THESE LEADING REFINERIES

COMPANY	ADDRESS	TYPE UNIT	COMPANY	ADDRESS	TYPE UNIT
Socony Mobil Oil Co., Inc.	Trenton, Michigan	TCC 75	General Petroleum Corp.	Torrance, California	TCR
Socony Mobil Oil Co., Inc.	Brooklyn, New York	TCC 75	Magnolia Petroleum Co.	Beaumont, Texas (3)	TCC 75
Socony Mobil Oil Co., Inc.	East Chicago, Indiana	TCC 75		(1)	TCC T-5
Socony Mobil Oil Co., Inc.	Buffalo, New York	TCC 75		(1)	TCR
Standard-Vacuum Refining Co. (Australia)	Altona, Australia	TCC 75	Phillips Petroleum Co.	Woods Cross, Utah	TCC 45
Socony Mobil Oil Co., Inc.	Augusta, Kansas	TCC 75	Phillips Petroleum Co.	Okmulgee, Oklahoma	TCC 45
Socony Mobil Oil Co., Inc.	East St. Louis, Illinois	TCC 75	Continental Oil Co.	Westlake, Louisiana	TCC 60
Socony Mobil Oil Co., Inc.	Paulsboro, New Jersey	TCC 75	Continental Oil Co.	Westlake, Louisiana	TCC 75
Mobil Oil Company, Ltd.	Coryton, England	TCC 60	Delta Refining Co.	Memphis, Tennessee	TCC 20
Mobil Oil Italiana S.p.A.	Naples, Italy	TCC 75	Pontiac Eastern Corp.	Purvis, Mississippi	TCC 100
General Petroleum Corp.	Ferndale, Washington	TCC 100	Neste Oy	Naantali, Finland	TCC 45

UNITED STATES PIPE & FOUNDRY CO.

Steel and Tubes Division

STEEL & TUBES · U.S. PIPE · DIVISION

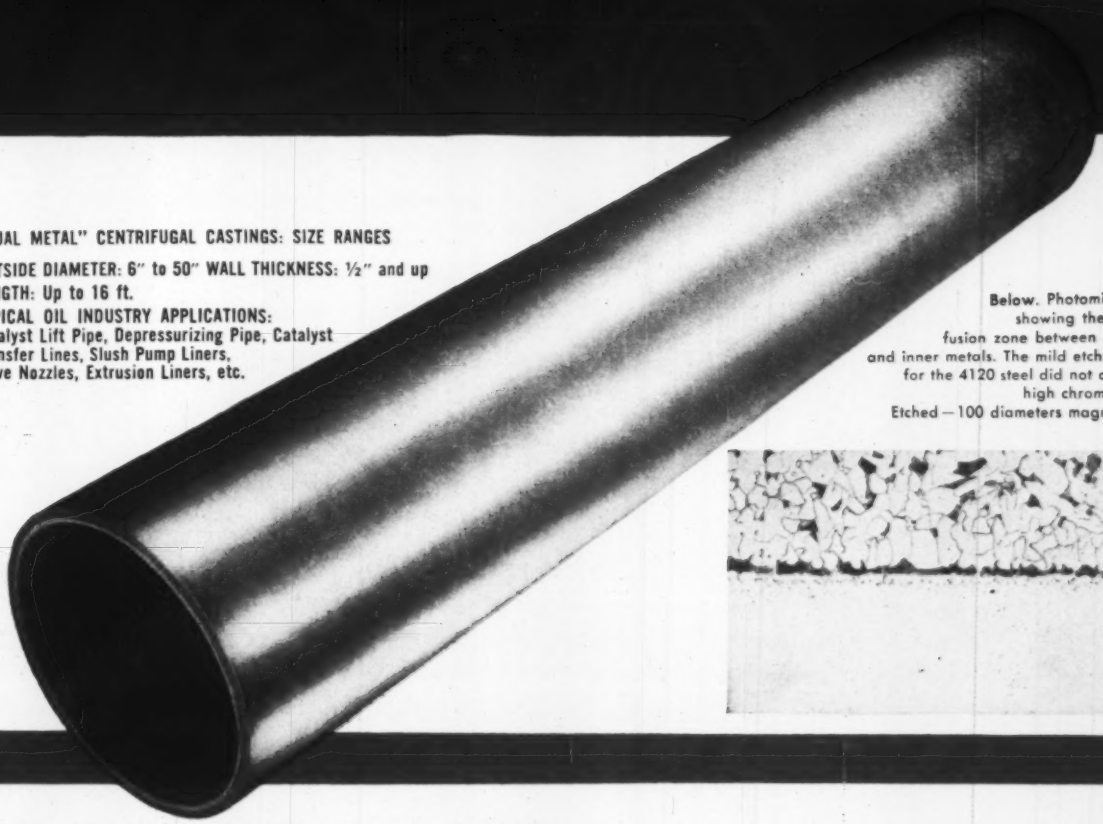
BURLINGTON, NEW JERSEY

SALES OFFICES: BURLINGTON, CHICAGO, CLEVELAND, HARTFORD, LOS ANGELES, NEW YORK, SAN FRANCISCO, ST. LOUIS

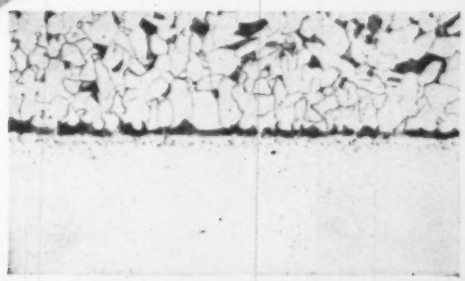
SAVE MONEY ON TURNAROUND

"DUAL METAL" CENTRIFUGAL CASTINGS: SIZE RANGES

OUTSIDE DIAMETER: 6" to 50" WALL THICKNESS: ½" and up
LENGTH: Up to 16 ft.
TYPICAL OIL INDUSTRY APPLICATIONS:
Catalyst Lift Pipe, Depressurizing Pipe, Catalyst Transfer Lines, Slush Pump Liners, Valve Nozzles, Extrusion Liners, etc.



Below. Photomicrograph showing the bond or fusion zone between the outer and inner metals. The mild etch required for the 4120 steel did not attack the high chromium iron. Etched—100 diameters magnification.



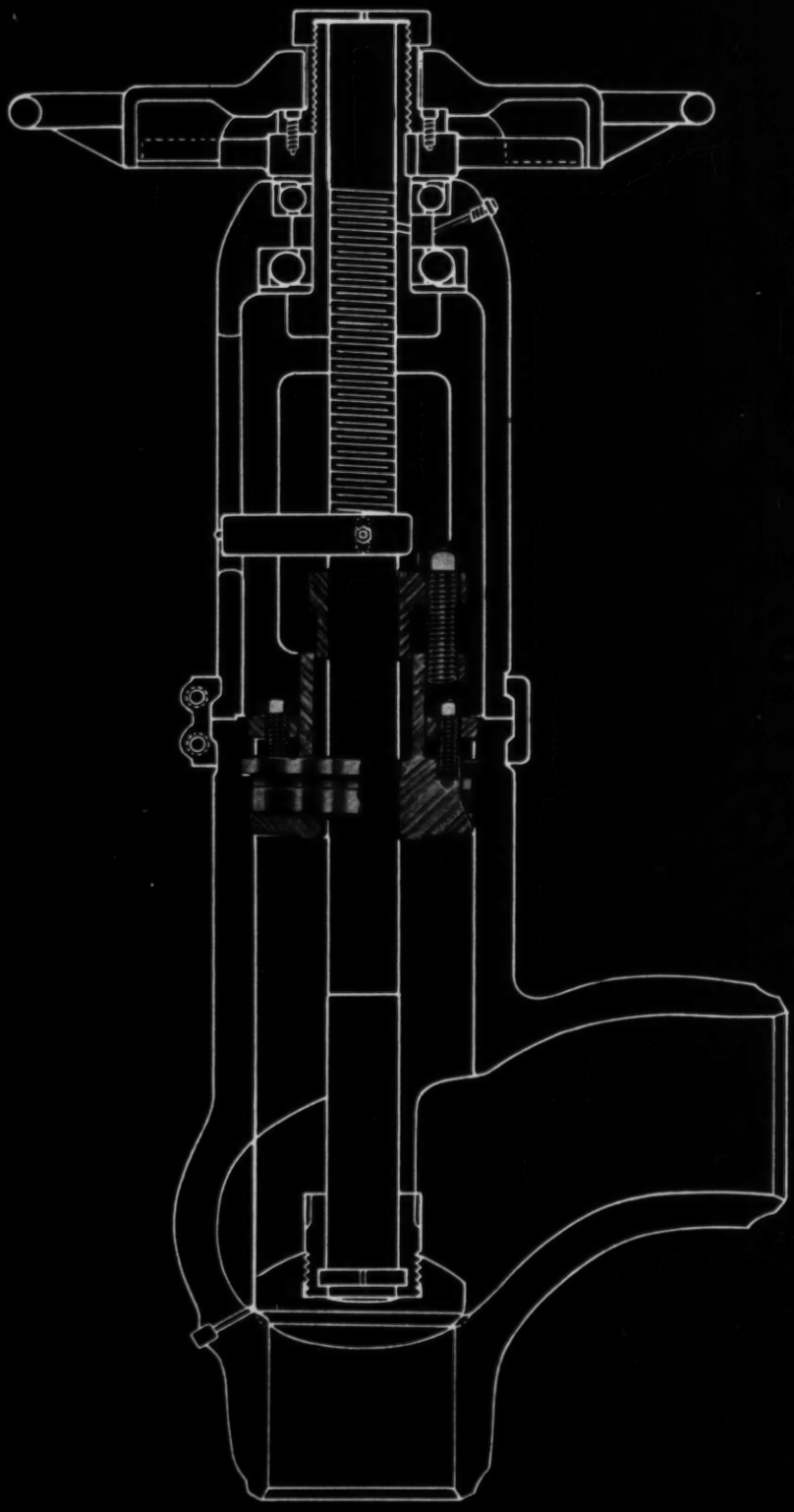
USE "DUAL METAL" LIFT PIPES

COMPANY	ADDRESS	TYPE UNIT
"ALBATROS" Société Anonyme Belge pour le Raffinage de Pétrole Installations Pétrolifères	Anvers-Kiel, Belgium	Houdriflow
The California Oil Company	Perth Amboy, New Jersey	Houdriflow
Texas City Refining, Inc.	Texas City, Texas	Houdriflow
Commonwealth Oil Refining Co., Inc.	Ponce, Puerto Rico	Houdriflow
Salt Lake Refining Co.	Salt Lake City, Utah	Houdriflow
Pure Oil Co.	Smith's Bluff, Texas	TCC
The Shamrock Oil & Gas Corp.	Sunray, Texas	Houdriflow
Purfina Italiana S.p.A.	Rome, Italy	TCC 11
	Genoa, Italy	TCC 11

COMPANY	ADDRESS	TYPE UNIT
Bay Refining Corp.	Bay City, Michigan	TCC 33
Hancock Oil Co.	Long Beach, California	TCC 40
Chinese Petroleum Corporation	Taiwan (Formosa) China	TCC 45
CONDOR S.p.A. Societa' per L'Industria Petrolifera e Chimica	Milan, Italy	TCC 75
The Standard Oil Co. (Ohio)	Cleveland, Ohio	TCC 75
Great Northern Oil Company	St. Paul, Minnesota	TCC 100X
American Petrofina, Inc.	Mt. Pleasant, Texas	TCC 60
Refinaria e Exploracao de Petroleo Uniao S.A.	Capuava, Brazil	TCC 120
Turkiye Petrolleri A.O.	Batman, Turkey	TCC 20
Erdol-Raffinerie Emsland	Lingen, Germany	Houdriflow

Cross-section view of dual metal piping consisting of a weldable SAE 4120 steel outer shell and a metallurgically bonded inner layer of high carbon-high chromium abrasion resisting iron. Photograph actual size. Composition of the hard inner layer:

C	Mn	P	S	Si	Cr
2.85	1.10	.009	.023	.85	29.36



EDWARD PRESSURE-SEAL ANGLE VALVE

What's New from Edward Valves

New Products . . . Problems and Solutions. . . Information on Steel Valves from Edward, Long-Time Leader in the Field!

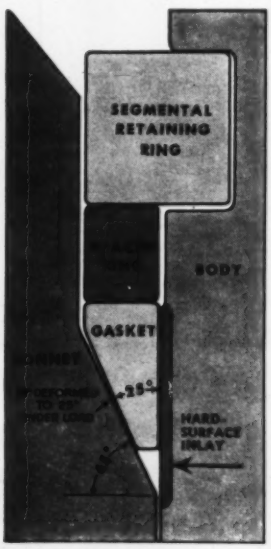
Not A Single Failure Reported In 5 Years

on unique "Pressure-Seal" body-bonnet joint!*

Advances in service temperatures (above 800 F) led to introduction, in 1945, of commercial steel valves with pressure-seal bonnet joint construction. These superseded bolted joint valves of earlier design.

The original 45° pressure-seal gasket, used by Edward and other manufacturers, was a significant improvement in minimizing leakage. But scientists in the Edward Research Laboratories refused to accept this as the best that could be done, set out to develop a better pressure seal joint.

In 1953 Edward research paid off: a completely new Edward pressure-seal design—with 25°–65° joint—was introduced. Design is shown in diagram on this page. The change in gasket angle, plus other Edward improvements described here, brought an end to bonnet joint leakage in pressure-seal valves.



Literally thousands of Edward pressure-seal valves have been installed since 1953 in a great variety of services. Of these, *not a single case of failure has ever been reported.*

Here's Why Edward Improved "Pressure-Seal" Succeeded:

SEALING AREA MULTIPLIED!
Improved gasket design *triples* sealing surface area, virtually eliminates possibility of leakage.

SEALING FORCE DOUBLED!
Angular relationship of bonnet, gasket and body directs more line load *outward* against the gasket, doubles sealing force.

SPECIAL GASKET SEAL-COATING!
A special corrosion-resistant malleable coating (.001 inch thick) is applied to gasket, flows into minute irregularities, assures perfect seal.

IMPROVED BODY SEALING SURFACE!
Possibility of any microscopic casting porosity in vital body-gasket sealing zone is avoided by inlay of corrosion resistant hard-surfacing material.

EASY DISASSEMBLY!
Body bore has been enlarged just above gasket area; this permits gasket to be easily lifted out, after segmental retaining ring and spacer are removed.

GASKET DAMAGE ELIMINATED!
Sharp edge of gasket has been rounded-off, eliminates possible damage to gasket during handling or storage.

EDWARD VALVES, INC.

1228 West 145th Street, East Chicago, Indiana

Subsidiary of

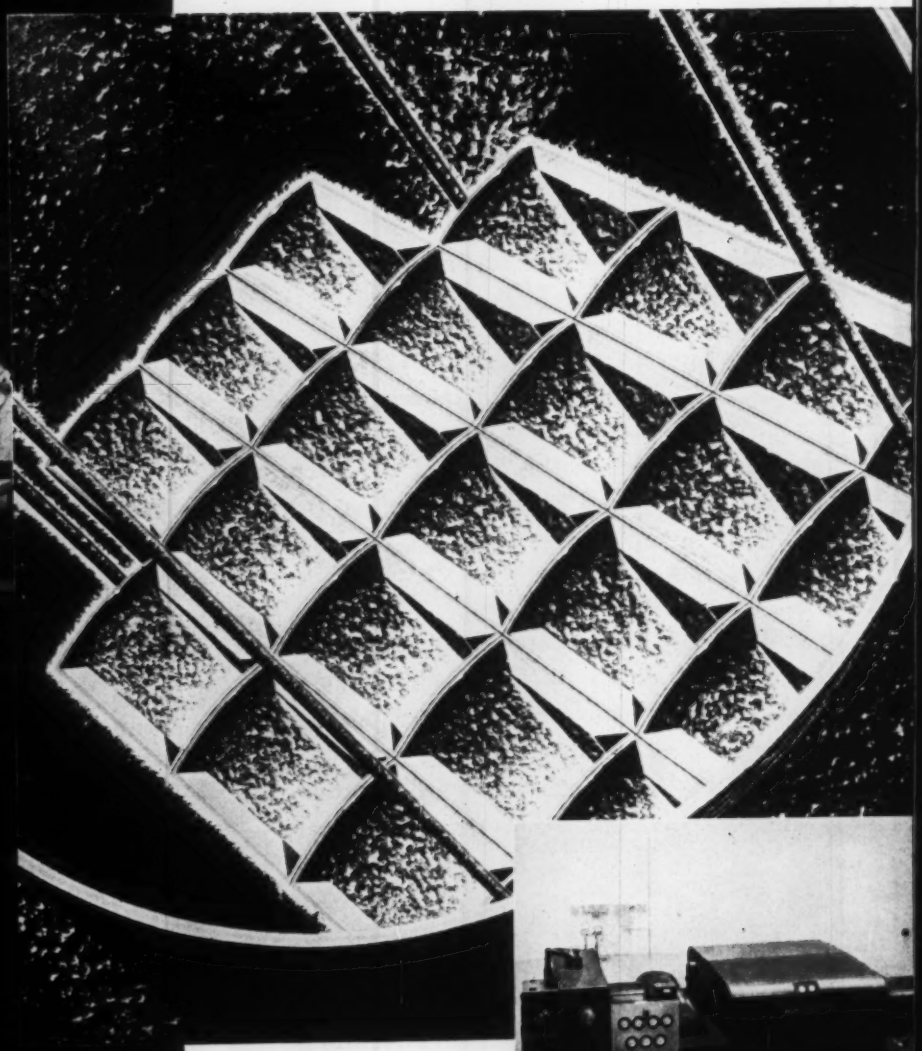
ROCKWELL MANUFACTURING COMPANY

Represented in Canada by
LYTLE ENGINEERING SPECIALTIES, LTD., 360 Notre Dame St. W., Montreal 1, Que.

Edward builds a complete line of forged and cast steel valves from ¼" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, gage and special designs; for pressures up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets; with screwed, welding or flanged ends.

*T. M. Reg. U. S. Pat Off.

NUCLEAR



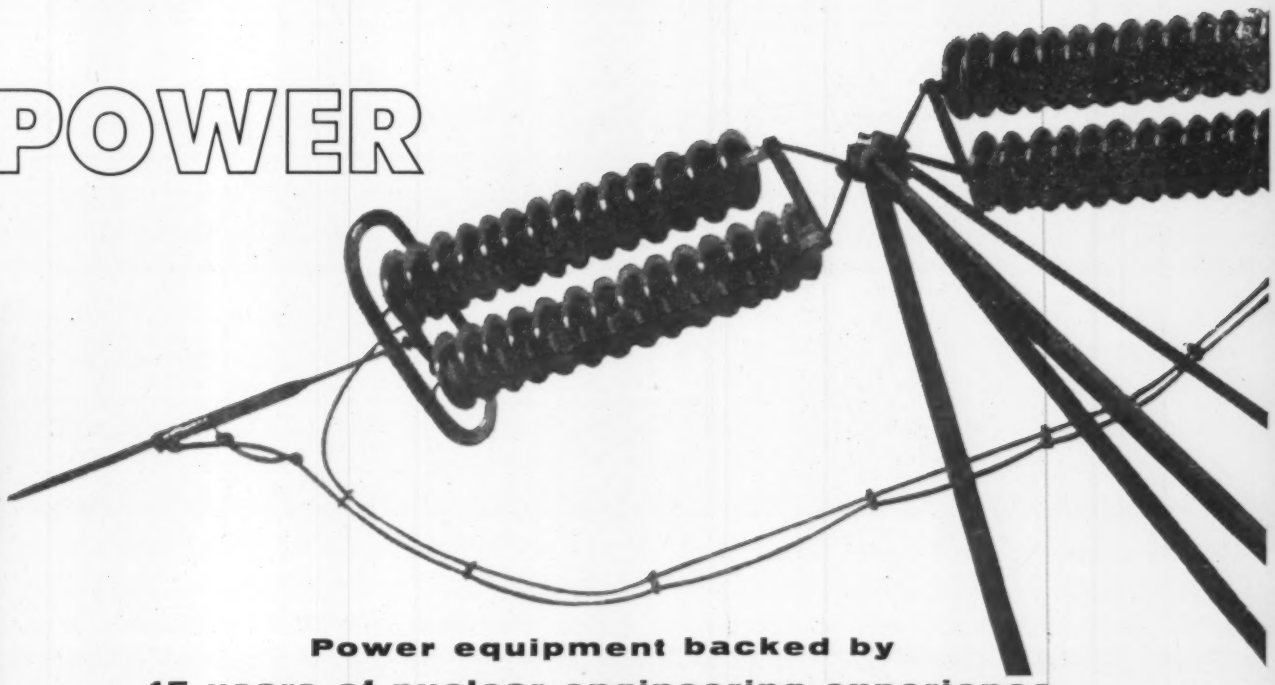
Reactors

Steam Turbine Generators

A-C
ALLIS CHALMERS

A-5790

POWER



Power equipment backed by 15 years of nuclear engineering experience

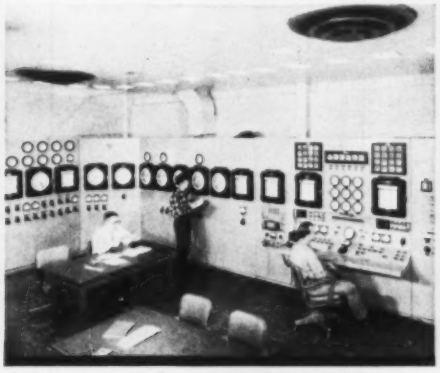
ALLIS-CHALMERS development of nuclear reactors and allied equipment is a logical outgrowth of 75 years of building basic power equipment.

With nuclear experience dating back to the Manhattan Project, facilities, engineering, and production skills are being utilized to produce nuclear power equipment with the same high standards that identify A-C steam turbine generators, condensers, pumps, water conditioning equipment, control, switchgear, breakers, and transformers.

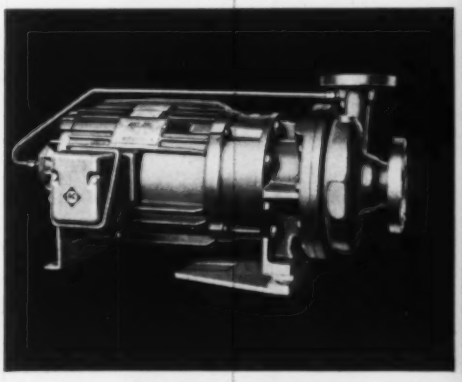
Allis-Chalmers is now engaged in the design and will construct a 66,000-kilowatt nuclear power plant* for the Northern States Power Company in cooperation with ten other electric companies.

Equipment and engineering for all nuclear power plant needs . . .

Condensers



Control and Switchgear



Nuclear Pumps

ALLIS-CHALMERS

*A model of a nuclear power plant using a Controlled Recirculation Boiling Reactor with nuclear superheater will be featured in the Allis-Chalmers exhibit in the United States Exhibition Area, Geneva Atoms for Peace Exhibition.

Simplify control problems...

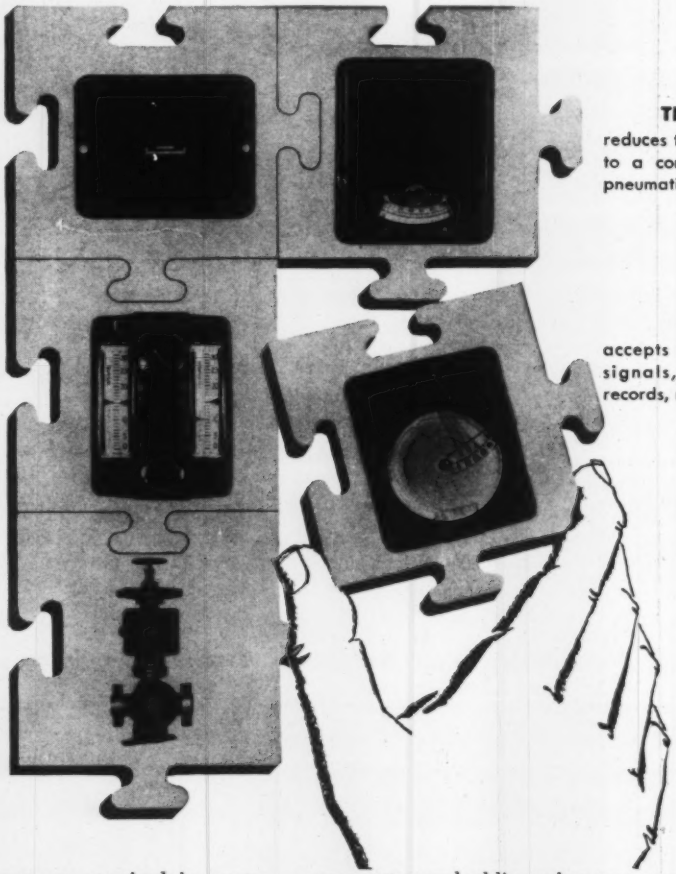
with the Bailey Building Block Method

Control problems are greatly simplified when you attack them using the Bailey Building Block Method. In a nutshell, the method consists of using standard components that fit together like building blocks. Virtually any control requirement can be handled by selecting standard components. Here are the parts you use and the functions they perform.

CONTROL RELAY
takes signals from the transmitter and computes corrective action in terms of pneumatic signals.

SELECTOR STATION
gives operator choice of hand or automatic control including set-point or bias adjustments.

POWER UNIT
is the "muscle" of the system. It performs whatever precise mechanical action is necessary to achieve control.



TRANSMITTER
reduces the measured variable to a common denominator, a pneumatic or electric signal.

RECEIVER
accepts pneumatic or electric signals, indicates and/or records, measurements.

Not all these components are required in every control system. You buy only what *your* system needs. When you change processes or add more automatic control, you can add additional standard components. Sometimes you may want to build a whole new system, re-using some of the existing components and adding other new ones. Spare parts inventory and maintenance training are reduced.

Hear the complete story of the Bailey Building Block System. Find how it can solve your control problems. See your Bailey Engineer or write for more information. G44-1

BAILEY METER COMPANY
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In Canada—Bailey Meter Company Limited, Montreal

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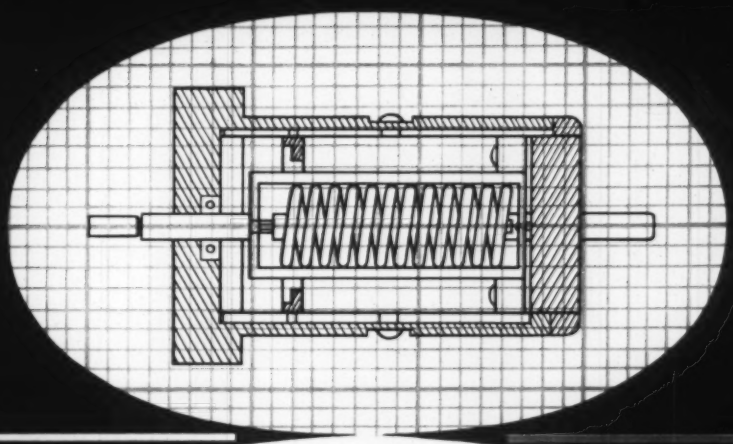
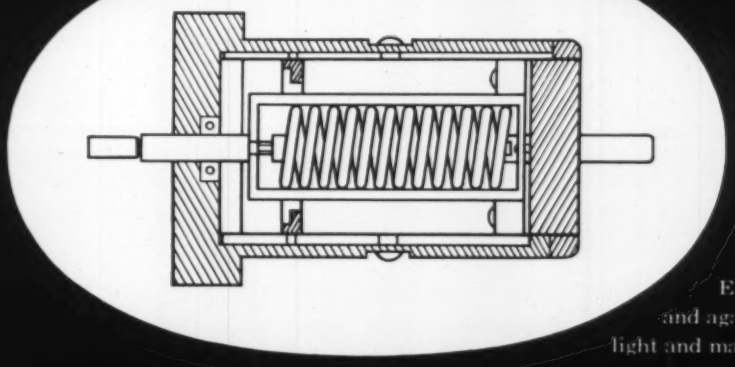


Quickly and accurately rendered to scale with blue grid lines to guide you. Guide lines are on back of drawing surface enabling you to erase and erase without disturbing them.



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10

College puts

coal at head of class

Otterbein College saves 42% with coal, installs revolutionary package boiler

Otterbein College, Westerville, Ohio, has discovered truly efficient heat generation. Otterbein's new heating plant burns coal in Coal-Pak boilers—developed by Bituminous Coal Research, Inc.—for automatic performance plus unique simplicity of operation. The result . . . savings in manpower . . . and a spotlessly clean plant.

In addition, comparative fuel cost studies have proved that coal costs 42% less per million Btu than the nearest competitive fuel in this area . . . a bonus savings! And, in keeping with the modern operation of this plant, the entire interior has been brightened by an attractive color scheme.

Facts you should know about coal

You'll find that bituminous coal is not only the lowest-cost fuel in most industrial areas but up-to-date coal burning equipment can give you 15% to 50% more steam per dollar. Today's automatic equipment can pare labor costs and eliminate smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at stable prices.

Technical advisory service

To help you with industrial fuel problems the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to the address below. Or send for our case history booklet, complete with data sheets. You'll find it informative.

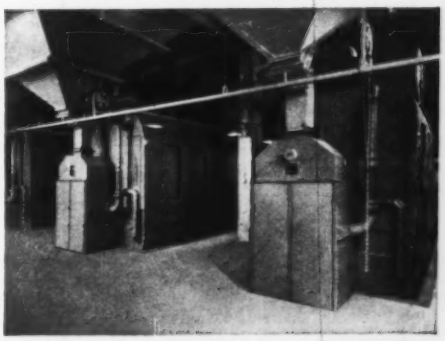
Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you in efficiency and fuel economy over the years.

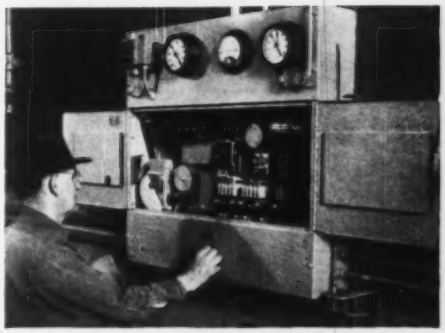
BITUMINOUS COAL INSTITUTE

Department ME-08

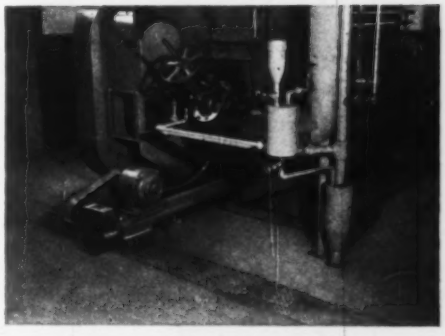
Southern Building • Washington 5, D. C.



Heating plant at Otterbein showing the three Coal-Pak Automatic Water Tube Generators, by International Boiler Works Co. (Licensed under pending patents of Bituminous Coal Research, Inc.) Coal storage hoppers at top of photograph hold 30-35 tons of coal each.



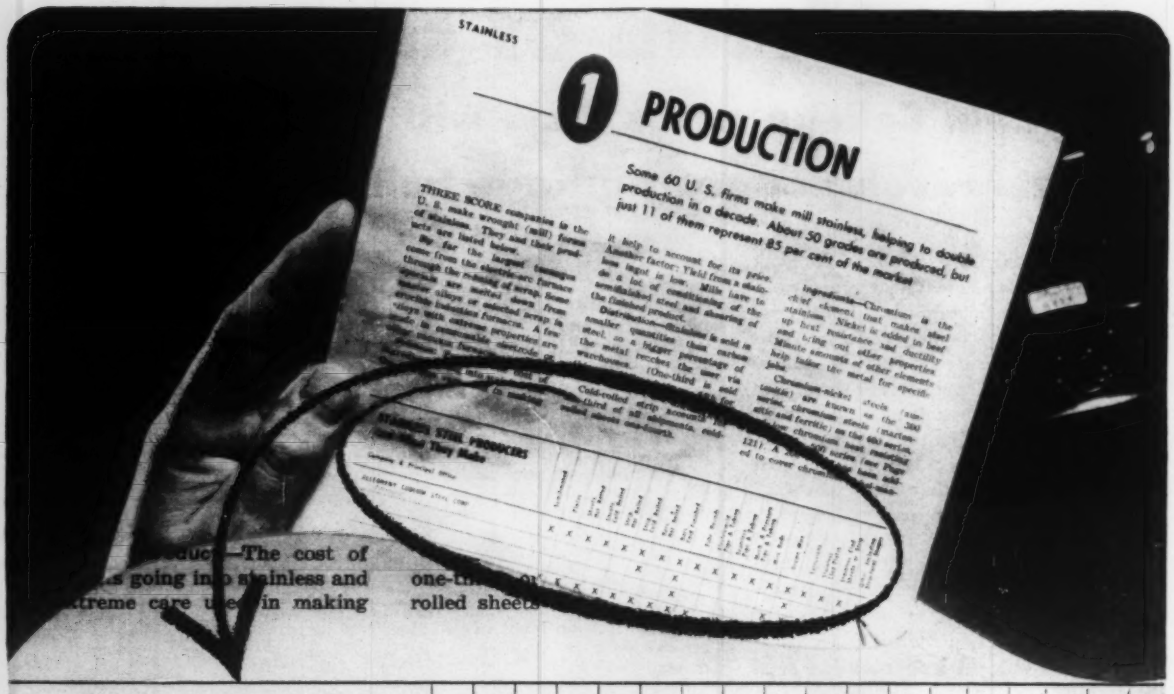
Single switch on front of cabinet enables operator to change from "run" to "hold-fire" operations. Each generator has its own rugged, non-electronic combustion control system, housed in tamper-proof locked cabinet. It controls safely and efficiently the starting-up sequence, coal feed, fuel-air ratio, hold-fire operation and ash removal.



Rear of generator, showing part of dustless ash disposal system. Ash removal is an integrated feature of the package operation—no manual handling. Ashes are removed by screw conveyor. They pass into main screw conveyor recessed into the floor (covered by metal plate) and are carried outside.

Coal is delivered by truck and dumped through any of nine manholes into storage hoppers below. From hoppers, it is gravity fed into stokers. Four-foot wall around coal dumping platform permits use of platform for outside coal storage, holding additional 250 tons.

Experience**—the added alloy in **A-L Stainless, Electrical and Tool Steels


STAINLESS
1 PRODUCTION
Some 60 U. S. firms make mill stainless, helping to double production in a decade. About 50 grades are produced, but just 11 of them represent 85 per cent of the market
THREE SCORE companies in the U. S. make wrought (mill) forms of stainless. They and their products are listed below.
It help to account for its price. Another factor: Yield from a stainless ingot is low. Mills have to do a lot of conditioning of the semifinished steel and shearing of the finished product.
Distribution—Stainless is sold in another quantities than carbon steel, so a bigger percentage of the metal reaches the user via warehouses. (One-third is sold
ingredients—Chromium is the chief element that makes steel stainless. Nickel is added in heat and corrosion resistance and ductility. Minute amounts of other elements help tailor the metal for specific jobs.
Chromium-nickel steels (austenitic) are known as the 300 series, chromium steels (martensitic and ferritic) as the 400 series.
Cold-rolled strip accounts for one-third of all stainless, cold-rolled sheets one-fourth.
STAINLESS STEEL PRODUCERS and What They Make
-The cost of
s going into stainless and
treme care used in making
one-th
rolled sheets

STAINLESS STEEL PRODUCERS and What They Make

Company & Principal Office	Semifinished	Plates	Sheets, Hot Rolled	Sheets, Cold Rolled	Strip, Hot Rolled	Strip, Cold Rolled	Bars, Hot Rolled	Bars, Cold Finished	Tube Rounds	Electricweld Pipe & Tubing	Seamless Pipe & Tubing	Mech. & Pressure Pipe & Tubing	Wire Rods	Drawn Wire	Extrusions	Stainless Clad Plates	Stainless Clad Sheets or Strip	Other, Including Structural Shapes
ALLEGHENY LUDLUM STEEL CORP. Pittsburgh	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
[illegible]						X		X						X				

Of the 60 producers of stainless steel...

only ALLEGHENY LUDLUM makes all sizes, shapes, finishes and analyses

In its November 4, 1957 issue, STEEL magazine published a complete run-down on the stainless steel industry. This article reveals that *only Allegheny Ludlum*, of the 60 some companies making stainless, produces all sizes, shapes, finishes and analyses.

This can save you considerable time and money. When you make Allegheny Ludlum your *one* source of stainless, you work with *one* sales engineer—*one* order, whether you buy sheet, strip, bars, tubing or whatever.

And, at the same time, you get the best technical service. A-L's crack research and development department is continually searching for new alloys, and better ways to use today's. Its findings are freely available to you through sales engineers, technicians and special literature.

Allegheny Ludlum follows the product from the melt through to finished form, has greater quality control over the stainless you buy. And since A-L makes all forms of stainless, you get unbiased recommendations as to what is best for your individual needs.

Profit by Allegheny Ludlum's status as the only one-source integrated supplier of all stainless forms. Call your A-L representative today . . . see how he can save you money and time. Or write *Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.*

WSW 7121

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EVERY FORM OF STAINLESS . . . . EVERY HELP IN USING IT

Modern Power...Processing... Military Might

CALL FOR

TAYLOR FORGE

FITTINGS • FLANGES • FORGED PARTS

A Special seamless 11" OD x 2.937" min. wall chrome moly vanadium alloy 180° Return for turbine piping use in supercritical (3500 psi at 1100F) power plant service.

B Manganese moly alloy Inlet Nozzle for nuclear reactor head on aircraft carrier (A2W) propulsion plant. This nozzle, which is 25¼" long, is bored throughout to an ID of 13¾". Outside diameters are 21¼" and 18¾".

C Stainless clad 16" OD x 1.093" wall 53° WeldELL with a 1" tangent on one end. The stainless lining is ¼" thick. Designed for aircraft carrier (A2W) nuclear propulsion plant piping, these fittings are made by a unique process developed entirely by Taylor Forge.

D Electric Fusion Welded Stainless Steel Pipe in sizes through 22" OD, made to extremely stringent specifications, and furnished in 20' lengths for primary coolant piping in the Commonwealth Edison Company's Dresden, Illinois, nuclear power steam generating plant.

E This 10" x 8" x 8" Schedule 160 Stainless Steel Wye is typical of special designs produced by Taylor Forge over the years for high pressure-temperature oil refinery service.

F There are almost no limitations as to size and wall thickness ratios in which WeldELLS can be produced. This 18" OD x 3.90" wall chrome moly fitting is designed for fossil fuel power plant service.

G Stainless Steel Welding Laterals of several sizes are used in reactor coolant piping in S5W atomic submarine propulsion plants. This is 14" x 10" x 10" size, with lateral at 50° 30' angle. Design conditions are 2500 psi at 650F.

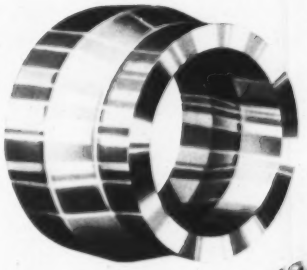
Also supplied for use in nuclear reactor piping is this special wall thickness 16" OD Stainless Steel Cap.

H

H

12" x 10" Schedule 160 Stainless Steel Concentric Reducer with square ends. Furnished for classified atomic research facility.

I



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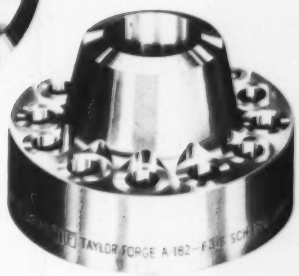
Taylor Forge is America's first and largest manufacturer of Forged Flanges. This 8" 2500 lb. Stainless Steel Welding Neck Flange with special spot facing is typical and flanges of this type are made for any pressure-temperature condition.

J



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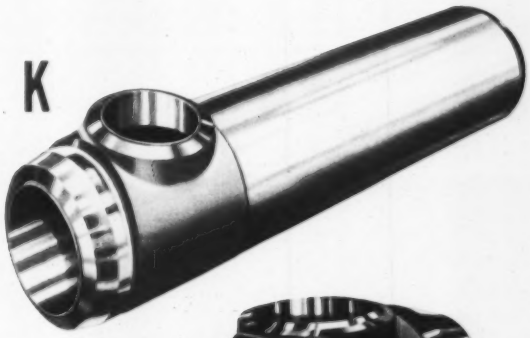
Special heavy wall Stainless Steel Header Type Fitting. Run is 14" OD and approximately 60" long with 12" outlet.

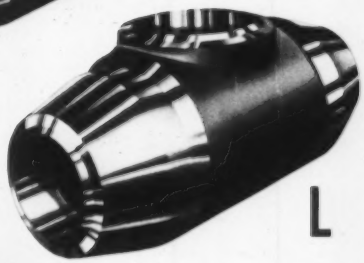
K



K

Bull Head Tees, such as the 8" x 8" x 12" Schedule 160 fitting pictured here, can often improve designs in high pressure-temperature oil refinery and power plant piping.

L



L

Contoured Outlet Headers are made by Taylor Forge in any required size, thickness and outlet arrangement. Widely used for Valve Settings, Gas Compressor Manifolds, Central Power Station Headers, etc., they also find many applications in the process industries.

M

M

. NICKEL . . . MONEL . . . INCONEL . . . HASTELLOY . . . EVERDUR . . . ALUMINUM . . . MAGNESIUM

TRADITIONALLY DEPENDABLE

For Nuclear OR FOSSIL FUEL Power Plant Service

Wherever piping requirements are extremely exacting, where even minute surface flaws cannot be tolerated and interior structure must be perfect—in other words, where the very highest *quality standards* must be maintained, TAYLOR FORGE can be relied upon as a completely dependable source for Welding Fittings, Forged Flanges and Nozzles, Forged Headers and other piping system and pressure vessel components.

The unusual designs and extremely stringent specifications encountered in nuclear power reactor piping provide an excellent example of such exacting requirements. And Taylor Forge has the distinction of having supplied essential parts for important nuclear installations, including nuclear powered steam generating plants and ship propulsion units, ever since the very birth of the "Atom Industry". In addition, Taylor Forge products are installed in every major facility for the production of fissionable materials.

This is quite understandable, of course, because for more than 50 years, Taylor Forge has been a recognized leader in the design and development of power piping and pressure vessel components.

...and for Process Piping

In this field, too, particularly in Petroleum Refining and Petro-Chemical plant operations, severe service conditions often impose most rigorous requirements, so restrictive as to call for greatest care in the selection of designs and materials.

And here, too, experienced engineers and designers have learned to "turn to TAYLOR FORGE" for piping and pressure vessel parts of unquestioned quality. Such products are available from Taylor Forge not only in carbon, alloy and stainless steels, but also in any other forgeable material that may be required.

...for Missile, Aircraft and Machinery Parts

Known everywhere as an outstanding producer of precision forged, rolled and extruded parts for missiles, jet engines and heavy machinery applications, Taylor Forge's eminence is even more emphatically recognized when these parts are required of special materials such as stainless, titanium, the newer so-called "exotic materials," and other metals generally classed as "hard-to-work".

The tremendously large and varied assortment of presses, hammers, ring rolling mills, special machines and related production equipment operated in the five U. S. plants of Taylor Forge (plus one in Canada) . . . the complete laboratory facilities for chemical, physical and metallurgical testing and control . . . the accumulation of superlative technical and engineering skills acquired during more than half a century of experience in this field . . . all these reasons justify the selection of Taylor Forge as the preferred supplier of such products.

UM . . . and all other forgeable metals

N Titanium Hemisphere for missile fuel bottle. This closed die hammer forging is 26" ID with ¾" thick wall. Also produced in other sizes and metals.

O Extruded jet engine component. This part is approximately 60" long with 24" diameter head and 4½" diameter shaft.

P Stainless Steel Turbine Shaft for jet engine. Both press forging and extruding operations are employed in forming this part.

Q This 42" OD x 16" long Stainless Steel Turbine Case is representative of products formed by Taylor Forge ring rolling methods. Seamless rings are made in sizes to 120" OD with practically any required section.

R Heat Sink for long range missile. This press forged Stainless Steel part is 64¾" OD and 1½" in wall thickness.

Welding Fittings . . . Forged Flanges . . .
Forged Headers . . . Welding Necks . . .
Missile and Aircraft Forgings . . .
Seamless Rolled Rings . . .
Electric Fusion Welded Pipe . . .
Spiral-Weld Pipe

T F

TAYLOR FORGE

The Complete Line

Welding Fittings,

Forged Flanges,

Large Diameter Rolled Flanges,

Welding Necks and related products

Includes every size, type, thickness, pressure rating and material covered by Standards, Tentative Standards, Standard Practices or Recommendations as issued by such regulatory bodies as:

Amn. Standards Assn. (ASA)
Amn. Soc. for Testing Mtls. (ASTM)
Amn. Soc. of Mech. Engineers (ASME)
Amn. Water Works Assn. (AWWA)
Tubular Exchanger Mfrs. Assn. (TEMA)
Mfrs. Standardization Soc. (MSS)
Amn. Gas Association (AGA)
Military and other governmental departments

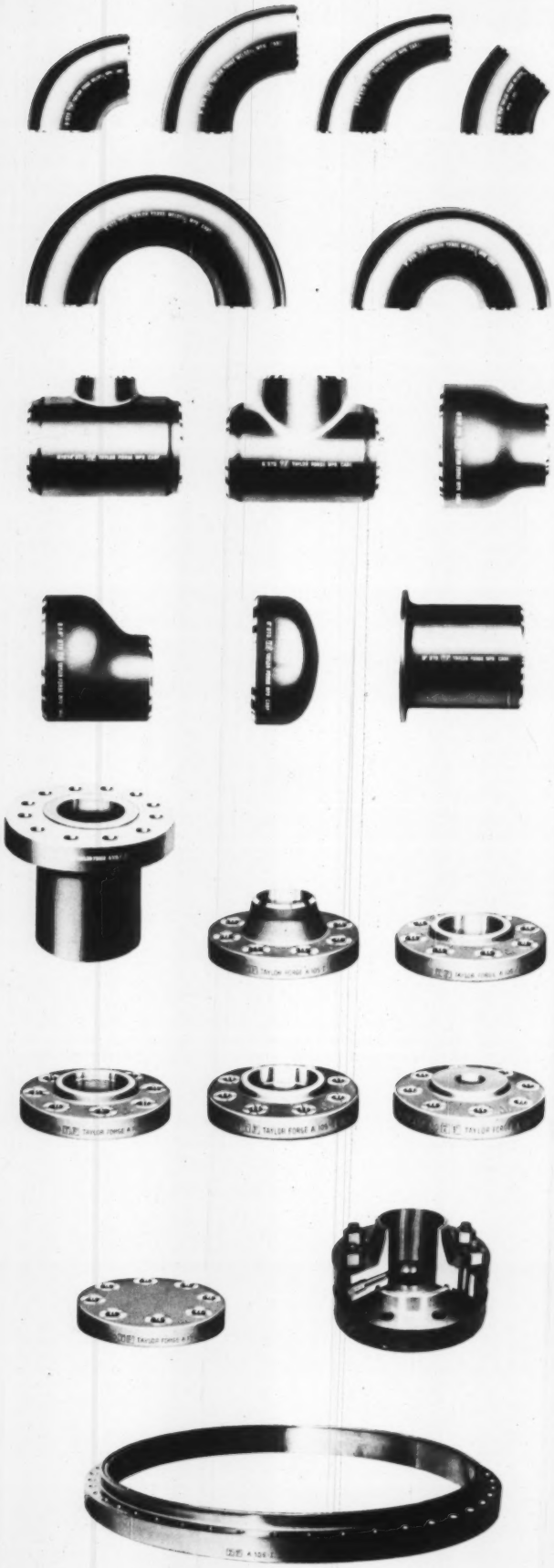
In addition, Taylor Forge manufactures a number of piping and pressure vessel parts of types not covered by, and in sizes extending beyond the range of any Standard.

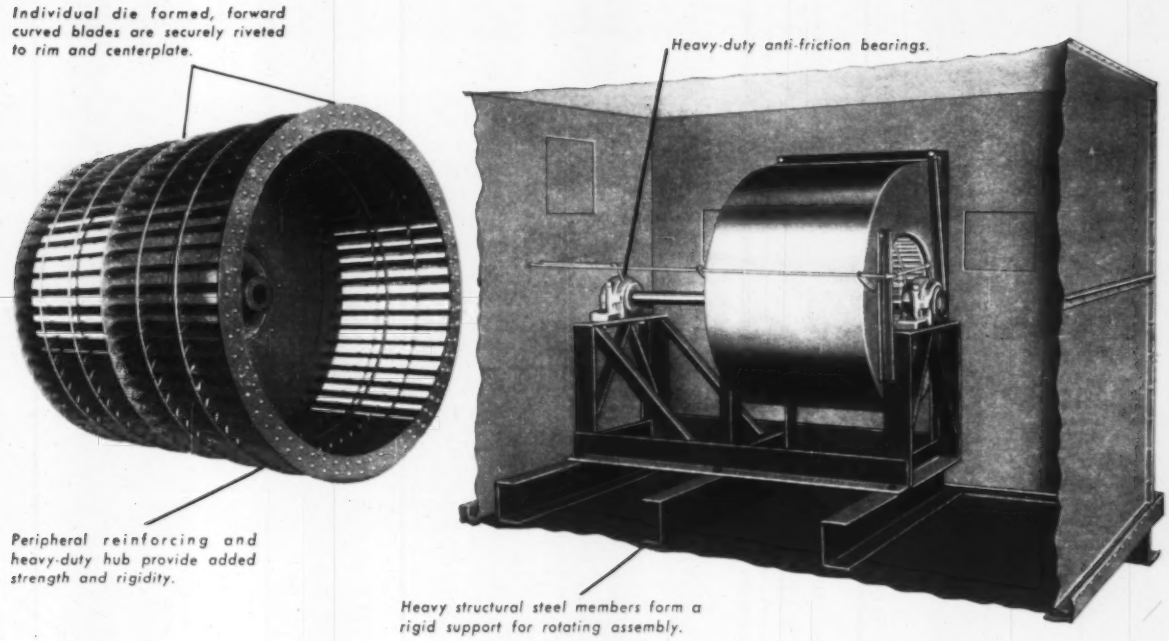
Taylor Forge & Pipe Works

General Offices and Works:
P.O. Box 485, Chicago 90, Ill.

Plants at: Carnegie, Pa., Gary, Ind., Houston, Texas, Fontana, Calif., Hamilton, Ont., Canada

District Sales Offices:
New York, Boston, Philadelphia, Pittsburgh, Atlanta, Chicago, Houston, Tulsa, Los Angeles, San Francisco, Seattle, Toronto, Calgary, Montreal.




Individual die formed, forward curved blades are securely riveted to rim and centerplate.
Heavy-duty anti-friction bearings.
Peripheral reinforcing and heavy-duty hub provide added strength and rigidity.
Heavy structural steel members form a rigid support for rotating assembly.

PROBLEM: High Velocity Air Conditioning Systems—to 8" SP

SOLUTION: Clarage Hi-Static Multitherm Units

High operating speeds, high duct velocities, high pressures — signal the choice of Clarage Hi-Static Multitherm Units. Available in 7 sizes with capacities from 2,500 to 22,000 CFM.

Unit components on the up-stream side include filters, humidifiers, cooling coils, and heating coils as required. In addition, the Hi-Static can be furnished in a sprayed coil type unit.

As shown above, special care in the design and construction of the fan section insures a stable, smooth operating unit. In every respect the Hi-Static Multitherm has what it takes for high velocity, conduit type air conditioning systems.

Write today for Bulletin 1312. Clarage Fan Co., Kalamazoo, Mich.

CLARAGE ... *dependable equipment for making air your servant*

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SOLID WHEEL

spells non-stop turbine performance

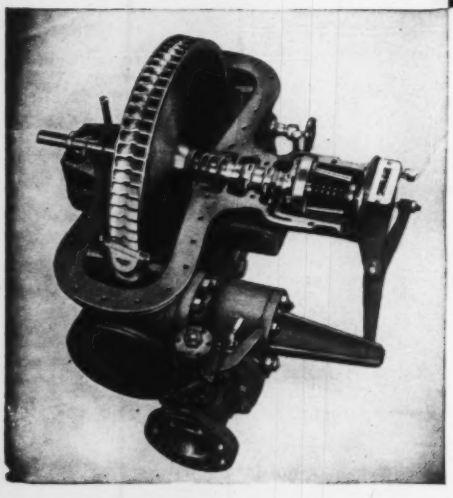
It's easy to see why Terry solid-wheel turbines have been setting non-stop records. They're built for long periods of continuous service.

The rotor, for example, is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to loosen or work out.

What's more, the blades can't foul. There is a one-inch clearance on either side of the wheel and the blades are double rim protected. There is no need for close axial blade clearance, because the steam enters the buckets at right angles to the shaft.

You, too, can profit from Terry solid-wheel stamina. Bulletin S-116 gives full details. Send for a copy today.

THE TERRY STEAM TURBINE CO.
Terry Square, Hartford 1, Conn.



Action of steam in a Terry solid-wheel turbine. The steam issues from an expanding nozzle at high velocity and enters the side of the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is caught in a stationary reversing chamber and returned again to the wheel. This process is repeated several times until practically all of the useful energy has been utilized.

TT-1205

TERRY

Linden Generating Station of Public Service Electric and Gas Company of New Jersey, where the first main steam line of Type 316 has been in service, on Unit No. 2, since December, 1957.

One of Kellogg's Many Power Piping Firsts

Public Service Electric and Gas Company's Linden Generating Station is the first utility plant to use Type 316 stainless steel for a main steam line. Installed in Unit No. 2, with throttle conditions of 2350 psi and 1100 F, this alloy piping is 11⅝ in. O.D. x 1 5/16 in. minimum wall thickness. The M. W. Kellogg Company fabricated this and other critical systems for this unit.

Kellogg's long list of "firsts" in power piping fabrication is due largely to its continuing studies in search for new alloys and new fabricating techniques which will permit industry to achieve still higher operating efficiencies. Kellogg is now working with Public Service of New Jersey on the main steam and other critical lines at Bergen and Mercer generating stations, utilizing austenitic and ferritic alloys.

Kellogg welcomes the opportunity to discuss its complete power piping design, fabrication, and erection facilities with consulting engineers, engineers of power generating companies, and manufacturers of boilers, turbines, and auxiliary equipment.

Fabricated Products Sales Division

THE M.W. KELLOGG COMPANY, 711 THIRD AVENUE, NEW YORK 17, N.Y.

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FIRST IN FABRICATION OF:

- Piping from C. ½% Mo.
- Station piping for 900 F.
- Station piping for 950 F.
- Station piping for 2200 psi.
- C. ½% Mo. piping with #3-#5 actual grain size
- 1¼% Cr.-½% Mo. steam piping
- Steam piping for 1000 F.
- ½% Cr.-½% Mo. station piping
- 2% Cr.-½% Mo. station piping
- Station piping for 1000 F.
- 2¼% Cr.-1% Mo. station piping
- 1¼% Cr.-½% Mo. station piping
- 1% Cr.-1% Mo. V. turbine piping
- 2¼% Cr.-1% Mo. V. station piping
- Station piping for 1050 F.
- 3% Cr.-1% Mo. station piping
- Type 347 stainless turbine piping
- Mercury vapor piping for 1000 F.
- Station piping for 1003 F. for France
- Type 347 stainless station piping
- Station piping for 1100 F.
- Type 316 stainless station piping
- Type 316 stainless station piping for 3500 psi-1050 F., 325 MW.
- Type 316 stainless station piping for 5600 psi-1200 F., 325 MW.

POWER PIPING—THE VITAL LINK

This Sandusky Centrifugal Casting—one of four produced for Westinghouse Atomic Equipment Department—meets radiographic, intergranular corrosion, and all other rigorous chemical and physical tests.

ONE SANDUSKY CENTRIFUGAL CASTING ...makes 4 giant stator shells

Specified by Westinghouse for 4 canned motor pumps soon to be integral parts of reactor system in Yankee Atomic Electric Plant in Rowe, Massachusetts

One king-size 17-ton Sandusky casting supplied the main motor bodies (stator shells) for the four pumps being built by Westinghouse, each to handle 23,600 g.p.m. of pressurized water through the reactor core.

The 25-foot-long Sandusky casting was centrifugally spun of a modified CF-8 (Type 304 L) stainless steel, then machined by Sandusky to a 3" wall thickness, 31½" on the O.D. This huge casting was hydrostatically tested to 3800 psi before being sectioned into four 68" lengths.

These stator shells represent another *new and exacting application* for Sandusky Centrifugal Castings—which may offer a practical and economical answer to *your* cylindrical requirements also. They are available in diameters from 7" to 54"—in lengths up to 33 feet—in heat- and corrosion-resistant stainless, carbon and low-alloy steels and a wide range of copper-base and nickel-base alloys.

Let us show you how Sandusky Centrifugal Castings can help solve your cylindrical problems. Write to us at Sandusky, Ohio.

SANDUSKY CENTRIFUGAL CASTINGS

FOUNDRY & MACHINE CO.

SANDUSKY, OHIO Stainless, Carbon, Low-Alloy Steels—Full Range Copper-Base, Nickel-Base Alloys

5,000 Homestead Valves chosen by A. B. Dick Co.

Homestead's leak-proof and stickproof qualities . . . plus their fast and positive action, result in trouble-free operation in a wide range of industrial applications.

For example, the more than 5,000 lubricated and non-lubricated Homestead Plug Valves in the A. B. Dick Company's Chicago plant control many difficult-to-handle services . . . such as aqueous and lacquer-type coatings, gas, duplicating inks and condensates. Write today to discover how Homestead Valves can reduce *your* operating costs.

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HOMESTEAD VALVE MANUFACTURING COMPANY
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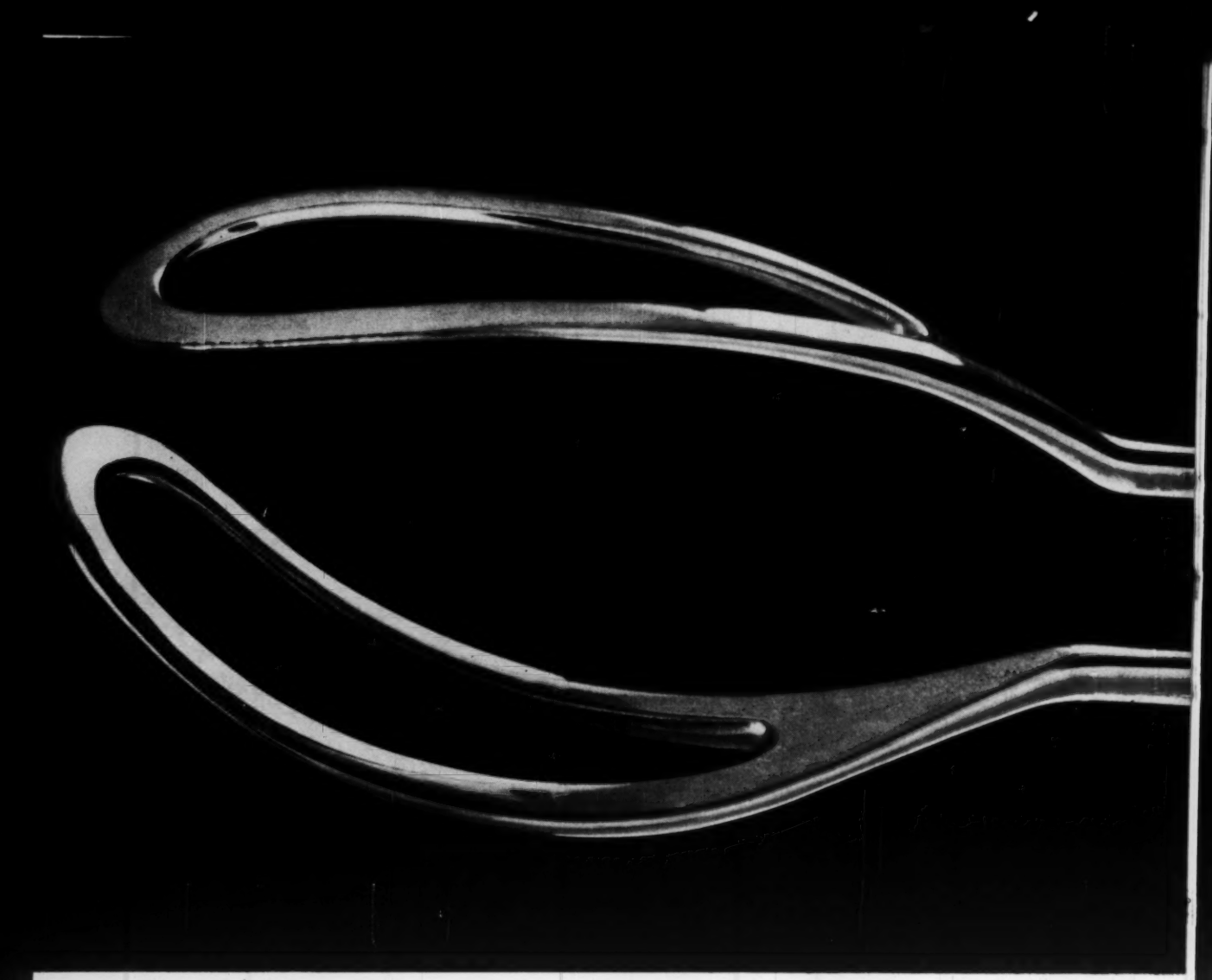


Corrosion Resistance It is an immutable law of Nature that all things seek their most stable state. Nitroglycerine craves opportunity to explode back into passive water and gas vapor. Radium glows silently as it decays into lead. Metals yearn to return to their oxides.

Corrosion is simply the return of a metal to its most stable form. It's an electrochemical process that is generally speeded up by the presence of salts, acids and moisture—in fact, at humidities below 50% there is virtually no atmospheric corrosion of steel. There are six common ways to minimize corrosion: select the right steel, apply protective coatings, install cathodic protection devices, set up periodic cleaning procedures, control the corrosive environment, and use *design* techniques which reduce the cost or likelihood of corrosion.

We have a record of one case where a manufacturer installed expensive piping to transport gaseous chemicals—overlooking the fact that ordinary carbon steel pipe would do the job just as well *if it were insulated* to prevent condensation of the chemicals inside the pipe. Sometimes a vessel is designed with great care so that it will hold a corrosive liquid, only to have the vessel attacked from the *outside* because the support brackets harbored pockets of moisture. And there are cases on record of stress corrosion failure because it was not recognized that stress relieving was necessary after cold working the metal.

Empirical corrosion information can be an excellent guide, but actual service records or true-to-life tests are the safest ways to judge a grade of steel, and you can often avoid the expense and time-consuming nature of making your own tests if you check first with United States Steel. A corrosion problem that is new to you may be familiar to us, and we may be able to supply you with information that will solve your particular problem promptly.

Another good reason for coming to United States Steel is this: no matter what kind of steel you need, you're sure to find it among the vast range of USS Steels for Design. The final selection, of course, should be made by a skilled metallurgist. Our technical staff is always available to consult with you about your problems. United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS, COR-TEN, TRI-TEN and "T-1" are registered trademarks

United States Steel Corporation • American Steel & Wire • Columbia-Geneva Steel • National Tube
Tennessee Coal & Iron • United States Steel Supply • United States Steel Export Company

USS **United States Steel**

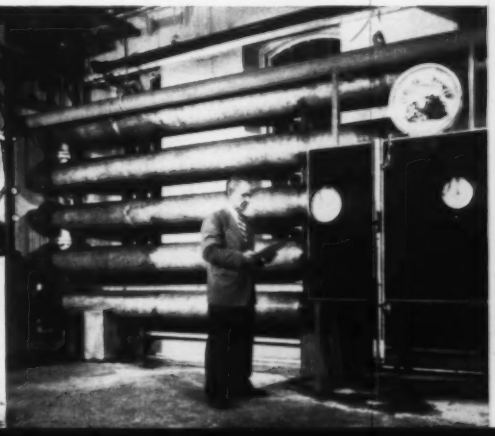
STEEL FOR OUTER SPACE

Stainless Steel obstetrical forceps

Lower Left—Problem: The City of Pittsburgh wanted a trouble-free hull on their new, all-steel fireboat. Solution: Paasch Marine Service built the hull with ¼" USS COR-TEN High-Strength Low-Alloy Steel. Payoff: A light, strong hull that has four to six times the atmospheric corrosion resistance of carbon steel plus superior paint adherence.

Lower Middle—Problem: Combat corrosion in the new Carquinez Strait Bridge by designing smooth, welded members eliminating details vulnerable to corrosion. Solution: USS "T-1" Constructional Alloy Steel and USS TRI-TEN High-Strength Low-Alloy Steel, both weldable and both having superior resistance to atmospheric corrosion. Payoff: The smooth, welded framework will assure much lower maintenance costs than the annual $70,000 needed to paint and maintain the old, riveted bridge. (And a bonus advantage: "T-1" Steel's high yield strength permitted strong, lightweight design, saving $800,000 in over-all cost.)

Lower Right—Problem: Design a preheating unit for a textile plant to handle hot water with a highly corrosive caustic soda content. Solution: 19,000 lineal feet of Type 304 Stainless Steel tubing inside the Stainless shells. Payoff: Ludell Manufacturing Company predicts that the unit will last indefinitely.



BUILT-IN ASSURANCE

To Help Make Your Plans Work As Specified...

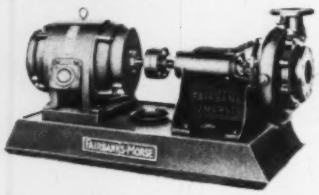
F-M BUILTOGETHER CENTRIFUGAL PUMPS

hot and cold liquids
liquid circulation
low-viscosity liquids
boiler feed
cooling towers, etc.

Up to 900 gpm., pressures to 525 ft. Close-coupled pump and motor units mount horizontal, vertical or angular. Sizes ¾" through 5".

F-M NON-CLOG PUMPS

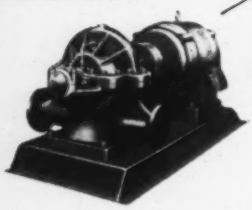
plant waste
slurries
paper stock
fruit
fish
vegetables, etc.



Up to 30,000 gpm., pressures to 175 ft. Sizes 2" through 20". Vertical or horizontal. Bladeless or conventional.

F-M SPLIT-CASE CENTRIFUGAL PUMPS

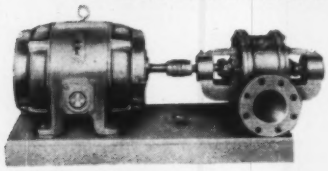
water supply; plant service
booster; circulating
air conditioning
refrigeration
chemical liquids
boiler feeds, etc.



Up to 50,000 gpm., pressures to 700 ft. Sizes 1½" through 36". Single stage or multistage.

For full information about Fairbanks-Morse pumps, call your F-M Sales Engineer or write Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.

F-M WESTCO PERIPHERAL PUMPS



boiler feed
condensate return
hot and cold liquids
chemicals
refrigerants, etc.

Up to 200 gpm., pressures to 900 ft. High pressure at normal operating speeds. Handle widely varying heads with little change in capacity. Sizes 1¼" through 2½".

The best-laid plans can go astray when mechanical equipment fails to deliver according to expectations or fails to give sustained peak performance. That's why Fairbanks-Morse builds something extra into all pumps so your plans work *as specified*.

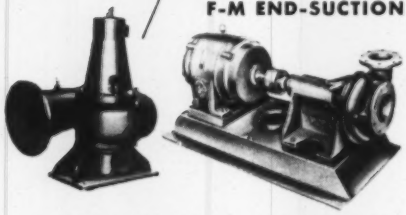
F-M Pumps You Can Rely Upon

Full-rated capacity guaranteed...with built-in safety margin to assure maximum efficiency under most severe use. Rugged, durable, precision-made to maintain efficiency with minimum service.

Expert Help When You Want It

F-M Engineers are ready to work with you on any of your pump problems.

F-M END-SUCTION PUMPS



hot and cold liquids
chemicals
circulating liquids
low-viscosity liquids
cooling towers
condenser circulation, etc.

Up to 100,000 gpm., pressures to 250 ft. Sizes ¾" through 54". Horizontal or vertical.

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY RAIL CARS • HOME WATER SERVICE EQUIPMENT • MAGNETOS

See...

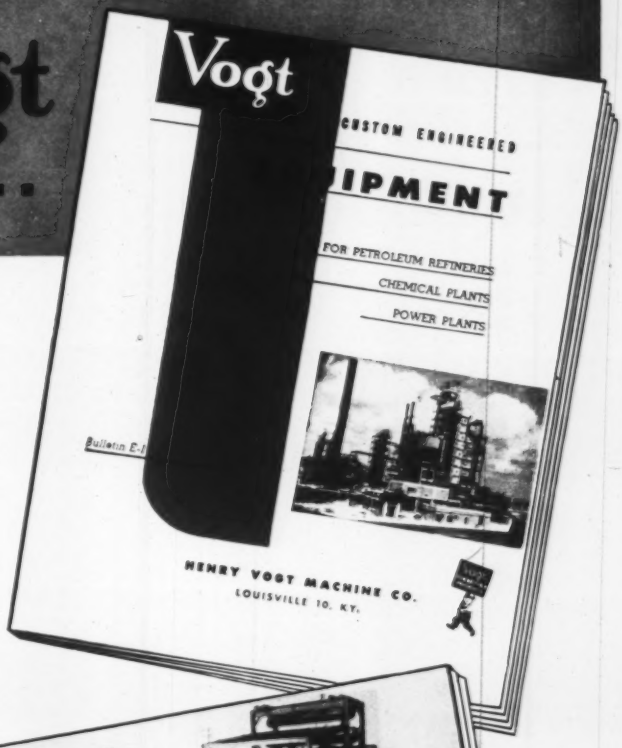
WHAT Vogt CAN DO FOR YOU..

Bulletin E-1 shows Vogt's advanced designs in heat exchangers, reactors, oil chillers, crystallizers, pressure vessels, steam generators and ice making and refrigerating machinery for countless applications in petroleum refineries, chemical plants, power plants and related industries.

Use the handy coupon below and send for your copy!

HENRY VOGT MACHINE CO.
Louisville 10, Ky.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.



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HENRY VOGT MACHINE CO.
10th & Ormsby Sts., Louisville 10, Ky.
Send copy of Bulletin E-1

NAME_____

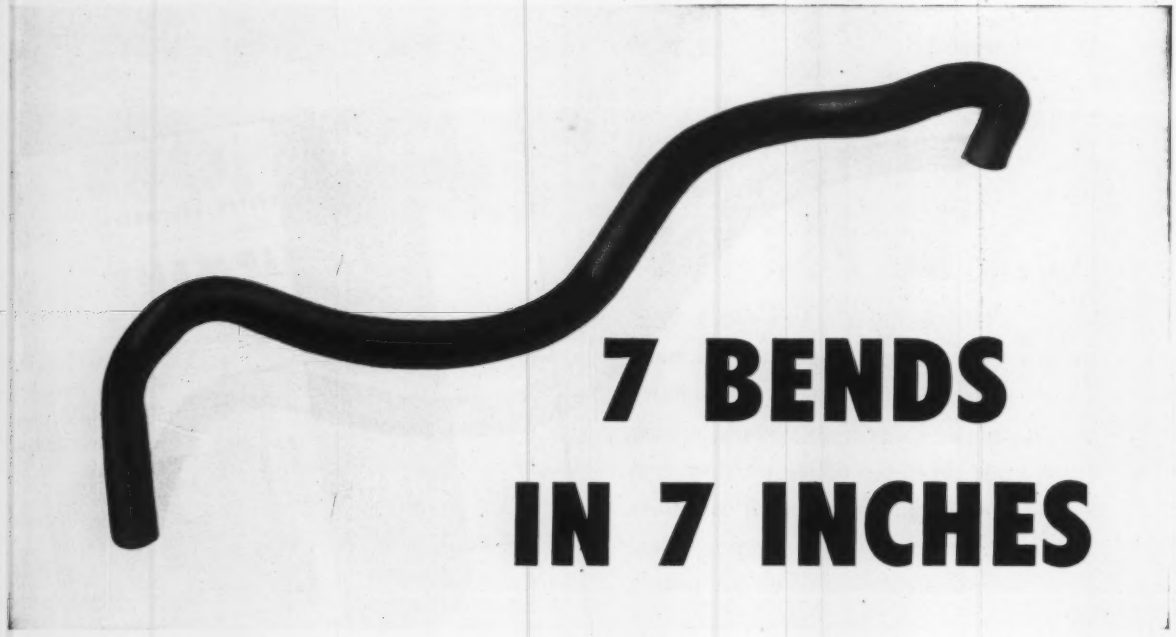
FIRM_____

STREET_____

CITY_____ State_____

24A-GM

Multiple-bend discharge tube for refrigeration compressor is fabricated economically on Bundy-designed fixtures. Seven bends are put into a 7" length of ¼ x .028" Bundyweld Tubing in just one semi-automatic operation.



7 BENDS IN 7 INCHES

Only Bundyweld Tubing could take the stress ...only Bundy could mass-produce the part!

This refrigeration-compressor discharge tube graphically illustrates the unique physical properties of Bundyweld® Tubing . . . and the skill of Bundy® fabrication experts.

Seven bends in just seven inches sets up terrific stresses—too many for ordinary tubing. Yet Bundyweld takes this punishment with ease . . . still stays *leakproof by test!*

Because Bundyweld is double-walled from a single *steel* strip, it's extra-tough . . . has high bursting strength and great resistance to vibration-fatigue. Result: Bundyweld has become the standard of the refrigeration industry; and it's also used on 95% of today's cars, in an average of 20 applications each.

See what you can do with Bundyweld Tubing! Our engineers will help out at any design-stage in the development of your product, from blueprint to assembly. In many cases, they'll have suggestions on how to make a part faster . . . or at lower cost.

And when the design is firmed up, turn it over to Bundy's skilled fabricators and relax. Using Bundy-designed machines and fixtures, they will mass-produce your parts at low unit-cost. Then they'll package your parts carefully . . . deliver them right on schedule – clean, bright and ready to use.

Whatever your tubing needs, Bundyweld Tubing and Bundy services can pay off for you. Find out more. Call, write or wire today!

BUNDY TUBING COMPANY • DETROIT 14, MICHIGAN

WORLD'S LARGEST PRODUCER OF SMALL-DIAMETER TUBING. AFFILIATED PLANTS IN AUSTRALIA, ENGLAND, FRANCE, GERMANY, AND ITALY

Bundyweld starts as a single strip of copper-coated steel. Then it's . . . continuously rolled twice around laterally into a tube of uniform thickness and passed through a furnace. Copper coating fuses with steel. Result . . . Bundyweld, double-walled and brazed through 360° of wall contact.

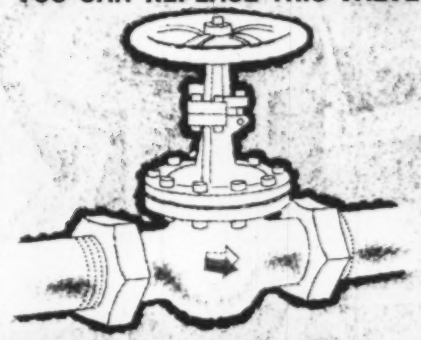
NOTE the exclusive Bundy-developed beveled edges, which afford a smoother joint, absence of bead, and less chance for any leakage.

THERE IS NO REAL SUBSTITUTE FOR

BUNDYWELD® TUBING

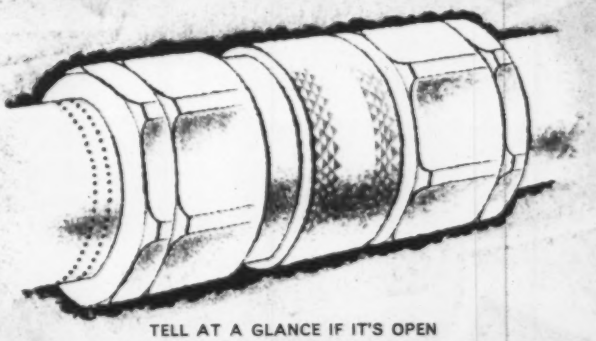
DOUBLE-WALLED FROM A SINGLE STRIP

YOU CAN REPLACE THIS VALVE



NO WAY TO KNOW IF IT'S OPEN OR SHUT WITHOUT TESTING.

WITH THIS SNAP-TITE VALVED COUPLING



TELL AT A GLANCE IF IT'S OPEN OR SHUT . . . NO TESTING.

A CHALLENGING NEW CONCEPT-

AUTOMATIC VALVING

The *instant* the two halves of the Snap-Tite valved coupling are connected there is full, free flow through it. No tedious turning of wheels as in conventional valves. When you want to shut off the Snap-Tite valved coupling, you just pull back the sleeve. You can tell at a glance the line is closed.

Leakage past conventional valves is difficult to find . . . not so with Snap-Tite valved couplings! Further, Snap-Tite valved couplings take up less space. So, why not switch to Snap-Tite automatic valving? Eliminate the possibility of incorrectly set or leaking valves and save time in installation and maintenance. Investigation might show considerable savings.

Sizes ¼″ to 10″ of all machineable metals

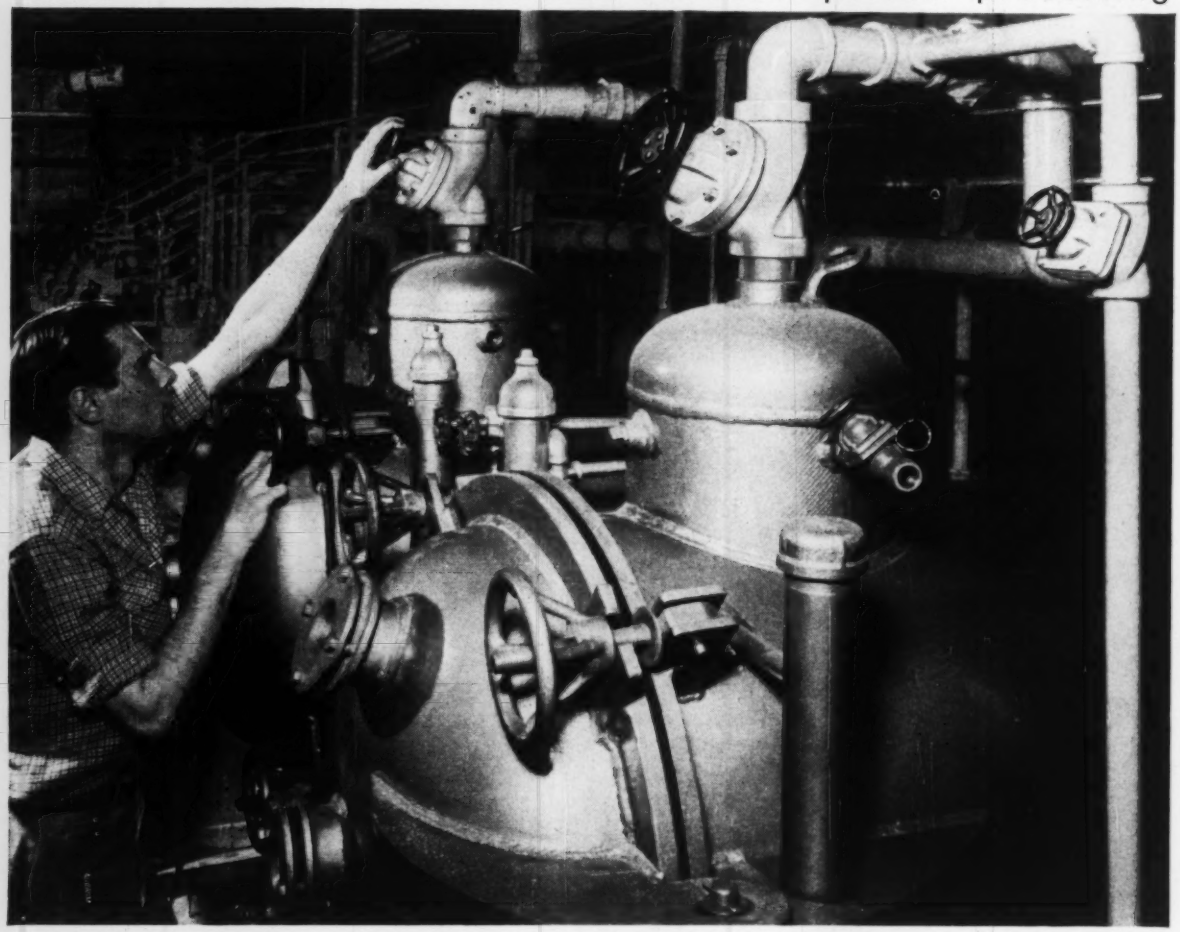
For more information, write for Snap-Tite catalog and, if you wish, outline your problem. Your local Snap-Tite representative will be glad to advise you.

SNAP-TITE COUPLINGS CAN HANDLE ALMOST ANYTHING THAT FLOWS

★ Snap-Tite, INC.

UNION CITY 4, PENNSYLVANIA

Packless valves assure Electron Products perfect processing



Crane diaphragm valves still hold tight after 18 months on 100-micron vacuum service

Electron Products Inc., Pasadena, Calif., forms special electronic parts of metalized paper. Processing—drying, deaerating, impregnating—is done under constant vacuum.

Valves, to hold the critical vacuum within a maximum leak rate of 100 microns for a 24-hour period during processing, had to be selected with care. Obviously not any valve would do. The choice—Crane diaphragm valves for high performance value.

After 18 months, these Crane packless valves continue to hold tight on this critical vacuum service for as long as 36 hours—and on occasion, over an entire weekend.

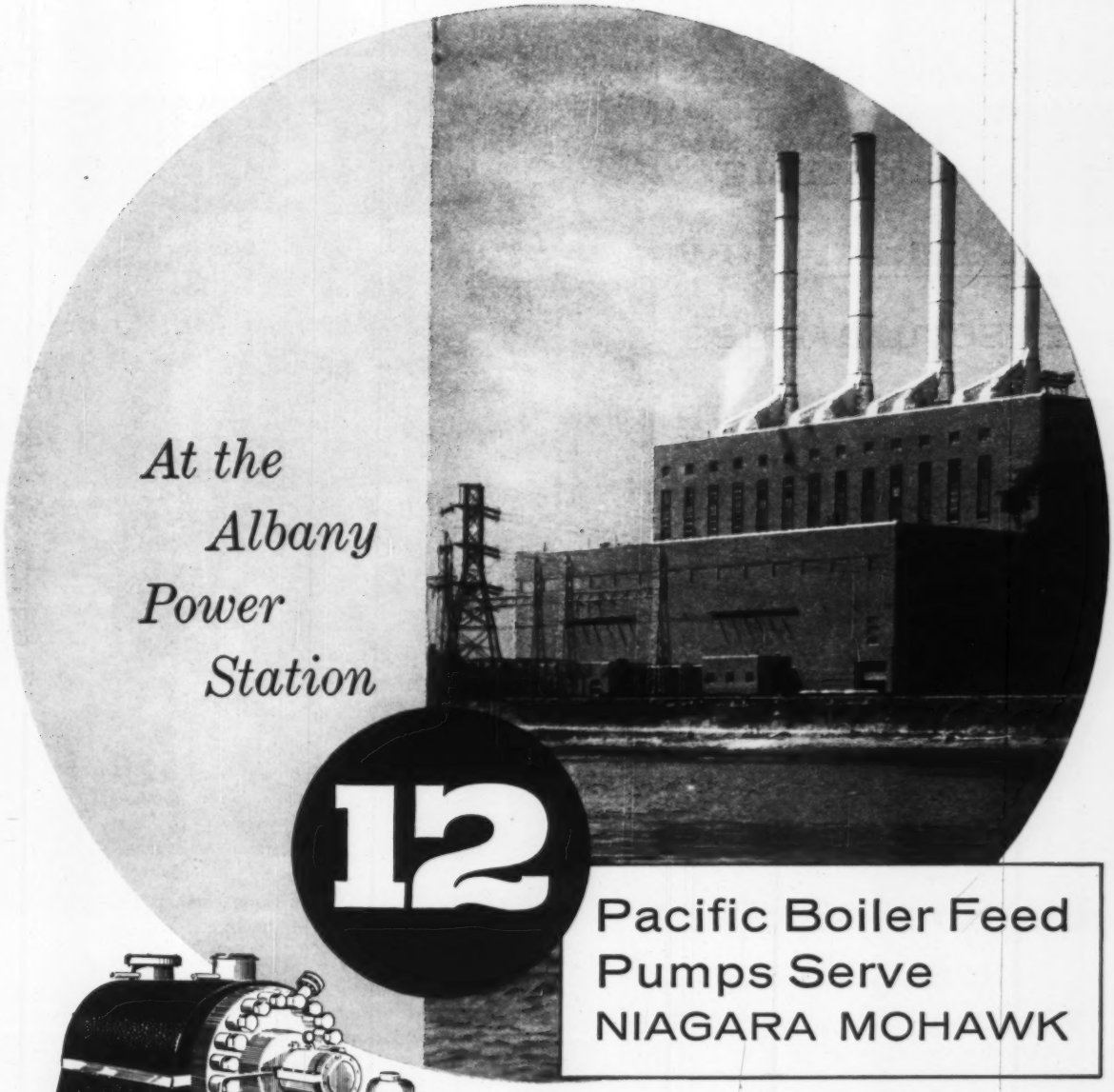
Crane packless diaphragm valves are widely used also in processing industries where absolute tightness is necessary to prevent leakage of volatile, corrosive and hard-to-hold fluids. Complete information is available from your Crane Representative. Or write for 24-page circular.

All about Crane diaphragm valves—patterns, body and trim materials, linings, 180 tested service suggestions, etc.—in Circular AD-1942. Send for it today.

CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

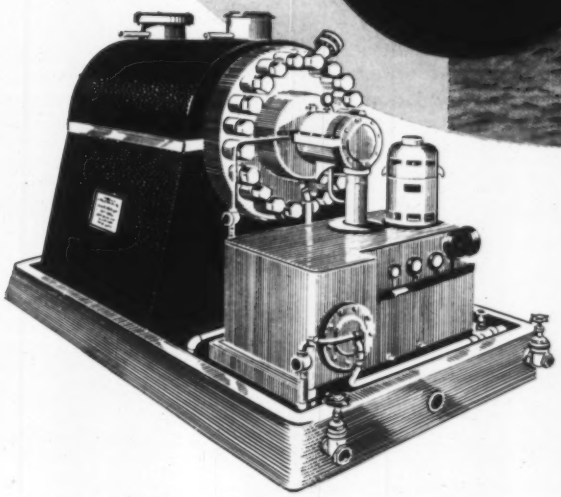
Since 1855—Crane Co., General Offices: Chicago 5, Ill.—Branches and Wholesalers Serving All Areas



At the Albany Power Station

12

Pacific Boiler Feed Pumps Serve NIAGARA MOHAWK



Following the original installation of 6 Pacific Type BFI Boiler Feed Pumps in 1951 Niagara Mohawk added a battery of 3 Pacific Boiler Feed Pumps in 1952—and 3 more in 1953.

This record of repeat orders (one of many similar records) provides hard, factual evidence as to the dependability, efficiency and excellent design built into every Pacific high pressure high speed boiler feed pump. For additional data on these reliable pumps write for Bulletin 122.

PACIFIC

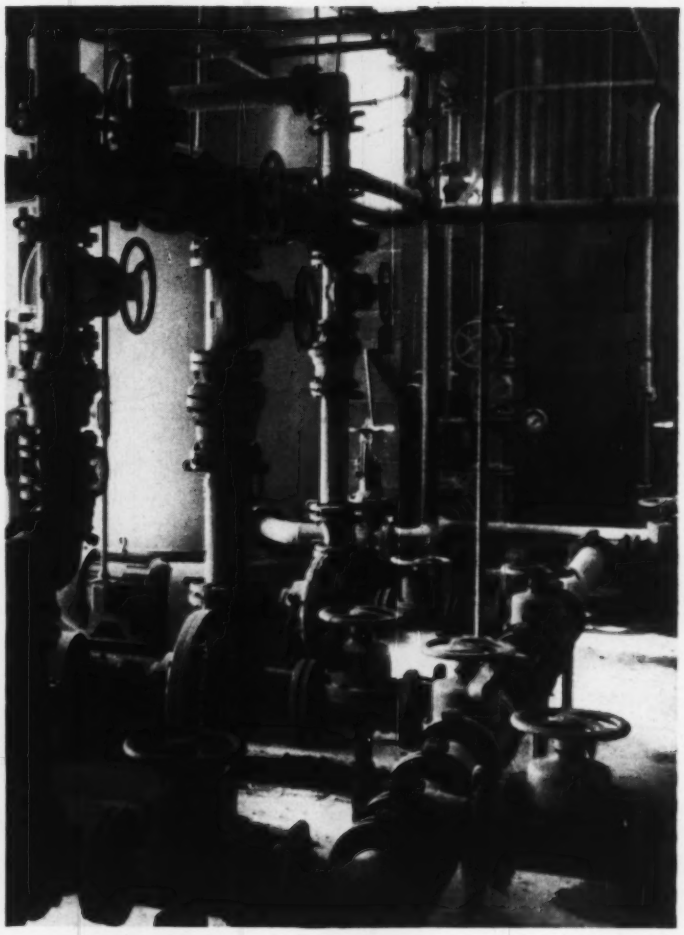
BF-28

PACIFIC PUMPS INC.

A Division of Dresser Industries, Inc.

HUNTINGTON PARK, CALIFORNIA

Maintaining maximum flow in serum lines with minimum pressure drop



Goodyear Tire & Rubber Company reports no valve clogging or interruption to flow in handling viscous fluids — with Grinnell-Saunders Straightway Diaphragm Valves.

Grinnell-Saunders Straightway Valves are now in use on serum lines of the Goodyear Tire & Rubber Company. Serum is a suspension of rubber particles in an acid brine solution. The installation pictured above is in Goodyear's Synthetic Rubber plant at Houston, Texas.

Grinnell-Saunders Straightway Valves were selected for this service because of their straight-through design. Material in process cannot build up and choke off flow because there are no pockets or gate trenches to trap solids. The straight-through feature also assures speed, ease and economy of rodding out, when necessary. When a diaphragm must be replaced — that job, too, can be done quickly, without removing the valve body from the line.

Isolation of operating parts from the fluid stream is still another important advantage of the Grinnell valve . . . eliminating corrosion and clogging of the valve mechanism while, at the same time, preventing contamination of product in the line.

Grinnell-Saunders Diaphragm Valves are available in a wide range of body, lining, and diaphragm materials to meet different service conditions. To secure further information, contact the Grinnell branch office nearest you — or write directly to Grinnell Company, Inc., 277 West Exchange Street, Providence, R. I.

Open

Diaphragm lifts high for streamlined flow in either direction. No irregular surface to trap deposits.

Closed

Diaphragm presses tight for positive closure, even when handling viscous or fibrous materials.

GRINNELL-SAUNDERS DIAPHRAGM VALVES

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

If steam costs give you

THAT FRUSTRATED FEELING . . .

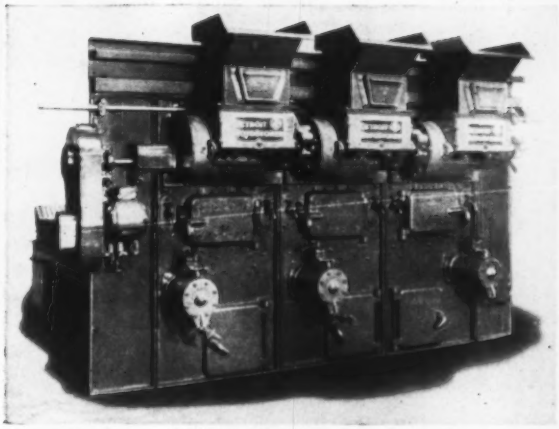
GET RID OF IT!

Modern DETROIT STOKERS under your present boilers will give you more steam at lower cost

If you can't get a new boiler plant you can still handle more load and reduce steam costs.

Many plants have done it by putting Detroit Stokers under existing boilers—to take advantage of improved combustion efficiency and higher burning rates. Savings and increased steaming capacities are substantial . . . are particularly worth while considering the moderate investment involved.

Let us show you the records of some of these plants. Investigation does not obligate you.



Detroit RotoStoker

One of the Detroit Stokers which will save you money. The line includes the LoStoker, UniStoker, Single Retort Stoker, Double Retort Stoker in the underfeed types . . . RotoStoker, RotoStoker Type CC (continuous cleaning) and RotoGrate Stoker (continuous ash discharge) in the spreader types.

There is a type and size of Detroit Stoker for any industrial or power need—3000 to 400,000 pounds steam per hour boiler capacity.

Detroit Stokers are available to burn all ranks of bituminous coals and lignites . . . and many waste and refuse fuels.

Our 60 years experience can be invaluable to you in selecting a type and size to meet your requirements.

Write for Bulletin.

Detroit Stokers cost less. Cost = initial investment + upkeep + production losses due to equipment outage. The total is less with Detroit.

COAL YOUR MOST ECONOMICAL FUEL

Most industrial plants are in areas where coal is the least expensive fuel. With Detroit Stokers it is by far the most economical.

DETROIT STOKER COMPANY

MAIN OFFICE AND WORKS • MONROE, MICHIGAN

District Offices or Representatives in Principal Cities

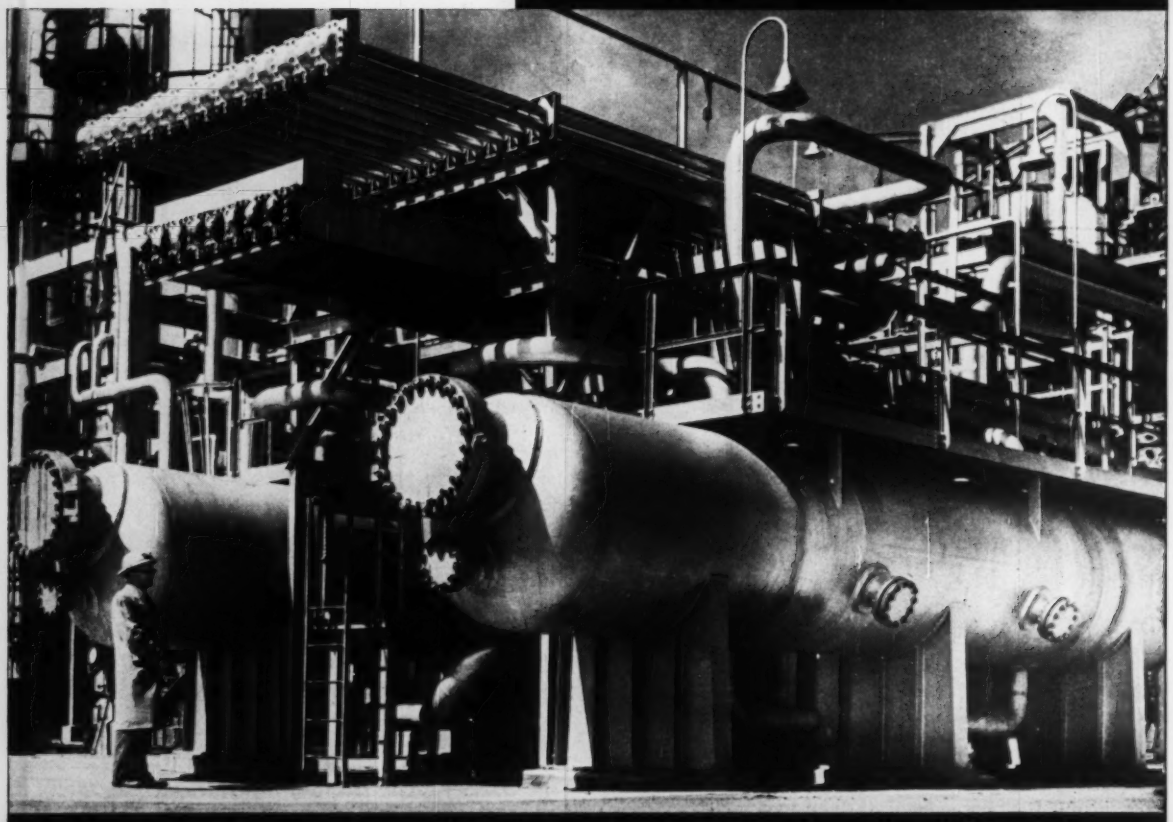
WHERE YOU DON'T DARE TAKE A CHANCE

...choose **LECTRODRYER®** for dependable DRYing

This huge Lectrodryer *must* stay on-stream until turn-around time. It dries recycle gas in the platforming operation, where moisture must not get through to foul the catalyst.

The engineers who specified this Lectrodryer based their selection on long experience with adsorbent dryers. They knew they could depend on Lectrodryers to provide efficient, dependable drying, year after year.

Whether your drying needs are for thousands of feet per hour or only a few—for drying air, gas or organic liquid—there is a Lectrodryer to do the job. Let our engineers help you select the *right* equipment for your particular drying needs. Pittsburgh Lectrodryer Division, McGraw-Edison Company, 303 32nd St., Pittsburgh 30, Pennsylvania.



Lectrodryer builds them BIG as well as small. This Type H unit is working at Sinclair Refining Company, Marcus Hook, Pennsylvania.

Leading industries look to

Lectrodryer® McGRAW EDISON

World's First and Foremost Manufacturer of Commercial and Industrial Adsorbent Dryers

User-survey shows—in all operating categories

FEATHER VALVE VOTED BEST

Simplest Construction:

- FEATHER VALVE
- VALVE A
- VALVE B

Lowest Maintenance:

- FEATHER VALVE
- VALVE A
- VALVE B

Most Efficient:

- FEATHER VALVE
- VALVE A
- VALVE B

Quietest:

- FEATHER VALVE
- VALVE A
- VALVE B

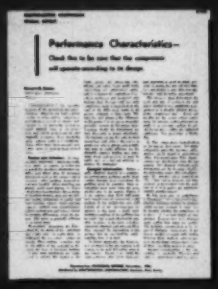
A recent survey among compressor-users showed this marked preference in all four operating categories for the amazing Feather* Valve. The Worthington Feather Valve is the lightest, fastest-acting compressor valve available. Because of its lightness and flexibility it provides very sharp action with virtually no slip or back-flow. And because it works with no impact . . . has no buffer plates or cushioning devices . . . it is all but indestructible, assures long-life with negligible maintenance costs.

To get the most in performance when you buy your next compressor, specify Worthington with the rugged Feather Valve feature. Worthington Corporation, Harrison, N. J.

*REG. U.S. PAT. OFF.

WORTHINGTON

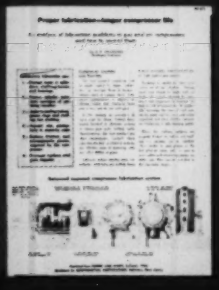
1. Reciprocating Compressors



2. Compressor Performance Characteristics

3. Selection of Heavy Duty Compressors

4. Capacity Control



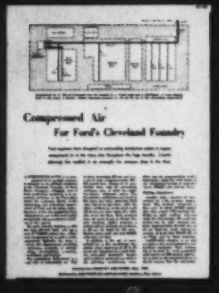
5. Compressor Lubrication

6. Compressed Air Piping

7. Compressor and Engine Foundations

8. Compressor Maintenance Clinic

9. Accessories and Protective Devices



10. Compressed Air for Ford's Cleveland Foundry

11. Picking Compressors for Air Sent Blowing

12. How to Erect a Stable Compressor Foundation

WORTHINGTON CORPORATION
Section 36-2 Harrison, New Jersey

Please send me articles checked:

☐ 1	☐ 4	☐ 7	☐ 10
☐ 2	☐ 5	☐ 8	☐ 11
☐ 3	☐ 6	☐ 9	☐ 12

☐ *I would like to discuss a compressor application. Please have an engineer call.*

NAME_____

COMPANY_____

ADDRESS_____

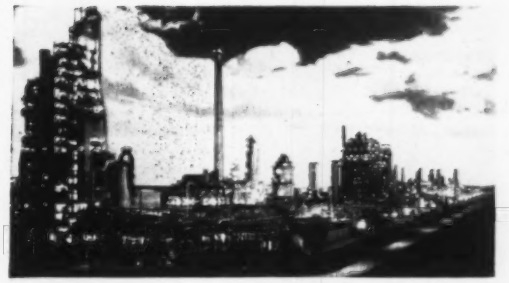
CITY AND STATE_____

PLAIN TALK

on water-cooled compressors

For your free copy of any of these informative articles on water-cooled compressors, write to Worthington Corporation, Harrison, New Jersey. In Canada: Worthington Canada Ltd., Brantford, Ont.

WORTHINGTON



A plant built on the philosophy of "don't accept anything at face value"...

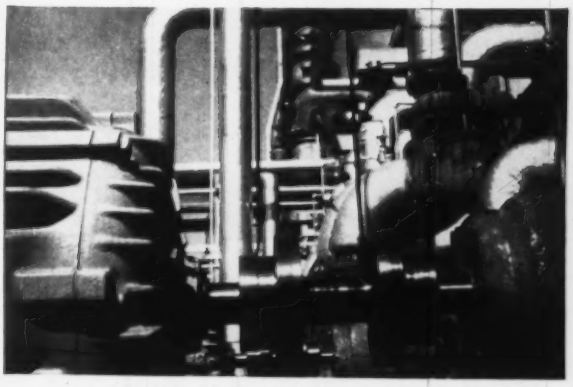
Tidewater's "Refinery of the Future" Uses 471 Fast's Couplings to Reduce Maintenance

IN PLANNING Tidewater's Delaware Refinery, all equipment purchases were examined from every angle . . . capital investment, manpower, maintenance and reliability. Fast's Self-Aligning Couplings were used throughout because they met Tidewater's exacting demands.

Tidewater's equipment design policies were established by survey teams that visited refineries all over the country. They carefully appraised each plant and asked operators what improvements they would make and what features they would retain if they were to redesign their drives.

In 471 applications at this refinery, Fast's Couplings guarantee mechanical flexibility that eliminates costly shutdowns and expensive shaft replacements. Fast's have the reputation of frequently outlasting the equipment they connect. This means savings in maintenance and down-time . . . in addition to protecting costly equipment against errors of alignment.

Nearly 40 years of coupling experience qualifies Koppers to solve *your* coupling problem. Write today for full details to: KOPPERS COMPANY, INC., Fast's Coupling Dept., 3408 Scott Street, Baltimore 3, Md.



Fast's Couplings give dependable, trouble-free service throughout Tidewater's entire production facilities.

This Fast's Coupling drives a pump delivering heavy naptha to the Solutizing plant.

Engineered Products
Sold with *Service*

KOPPERS

THE ORIGINAL
FAST'S Couplings

In Leland submersible pump motors

GRAPHITAR® (CARBON-GRAPHITE) and GRAMIX® (PRODUCTS OF POWDER METALLURGY)

operate with gasoline

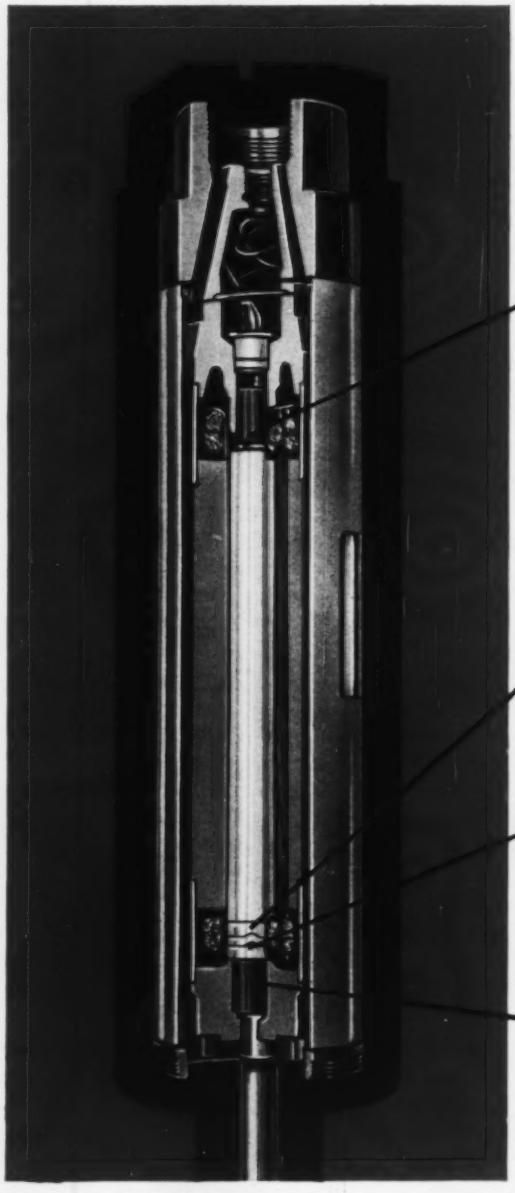
as the only lubricant!

Running directly in gasoline, this superbly-designed Leland submersible motor embodies two GRAMIX thrust washers and two GRAPHITAR bearings to keep the operation of this amazing explosion-proof pump motor safe and smooth.

Thirty years ago the manufacturer of these pumps—the Leland Electric Co., Dayton, Ohio, a division of American Machine and Foundry Co., developed the first gasoline curb-pump motor to receive Underwriters' Laboratories' approval. Throughout their long experience, they have selected every component with great care. It is thus significant that for Leland's submersible motor they selected GRAPHITAR and GRAMIX bearings.

GRAPHITAR is a non-metallic, carbon-graphite material that will not weld or score even when in contact with a metal shaft. Any liquid will act as a lubricant, thereby reducing friction and increasing service life. With low-viscosity liquids such as gasoline, friction is at a minimum because of the low film strength.

GRAMIX, tough, long-wearing sintered-metal, has an extremely high particle hardness and excellent surface finish; can be precision die-pressed to tolerances within .0005". GRAMIX parts can withstand incredible amounts of pounding action. These factors, coupled with their extremely low cost, have helped add to the increasing use of GRAMIX parts in many industries.



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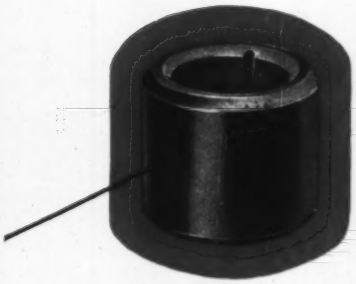

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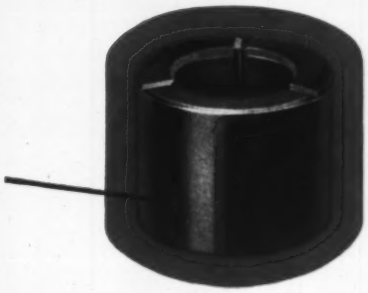

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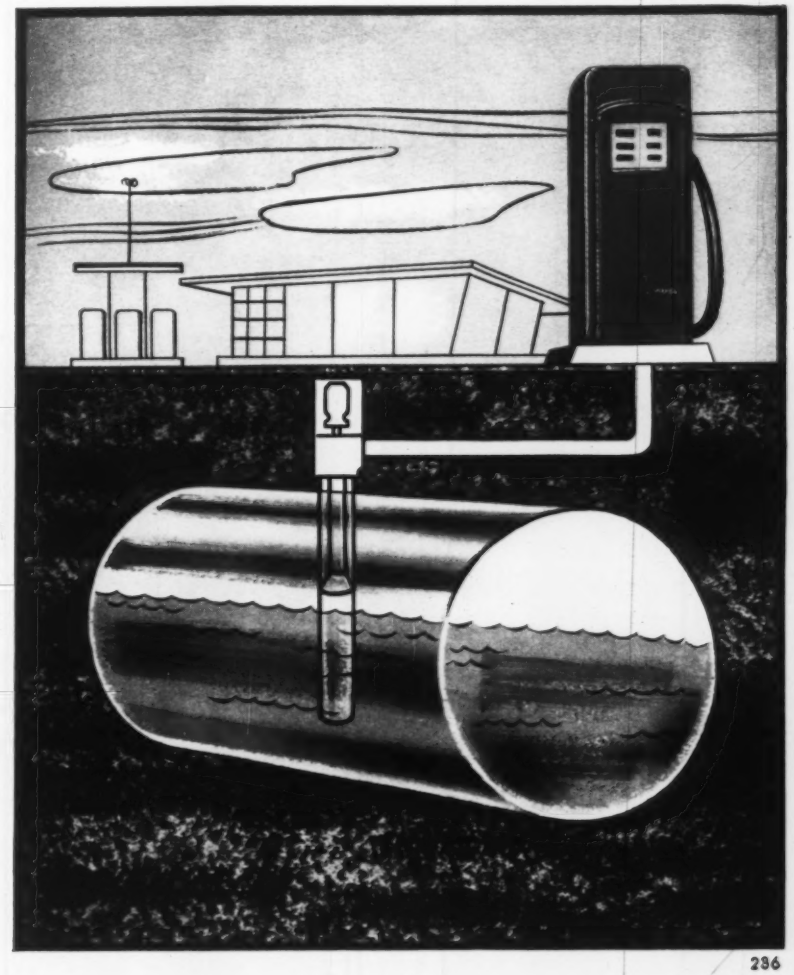

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Write today for these two new engineering bulletins, GRAPHITAR Bulletin No. 20 and GRAMIX Bulletin No. 21.

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- Good Regulation • Smooth Control
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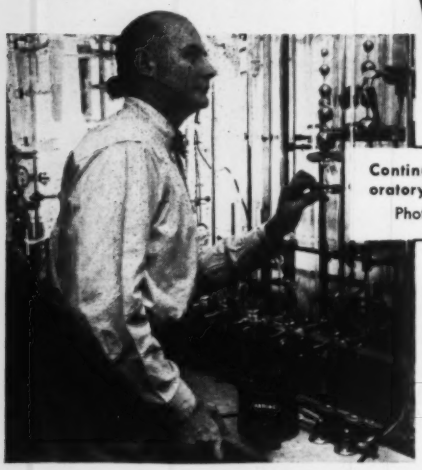

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Photo Courtesy Bell Telephone Laboratories

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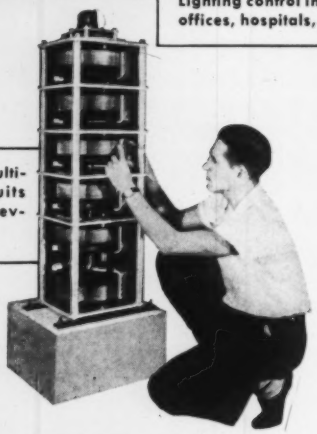

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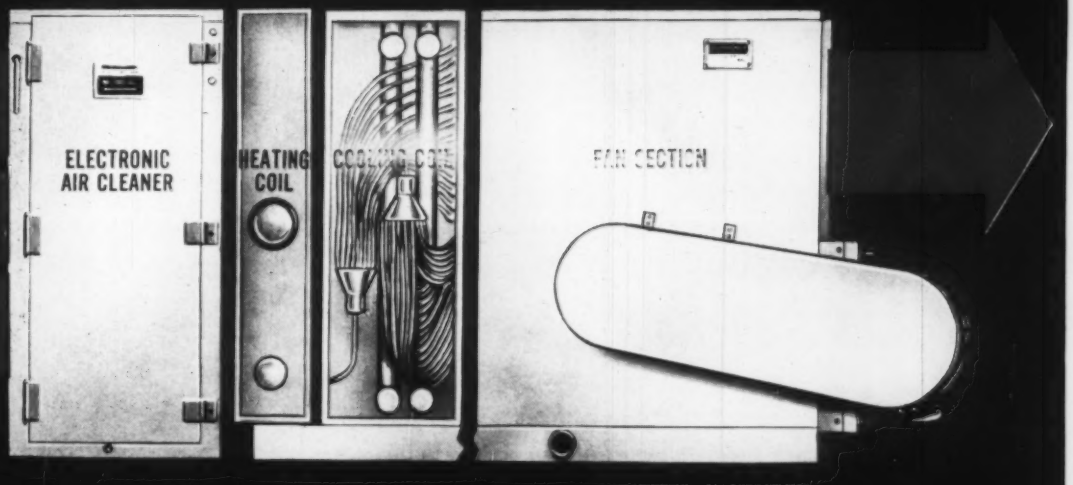

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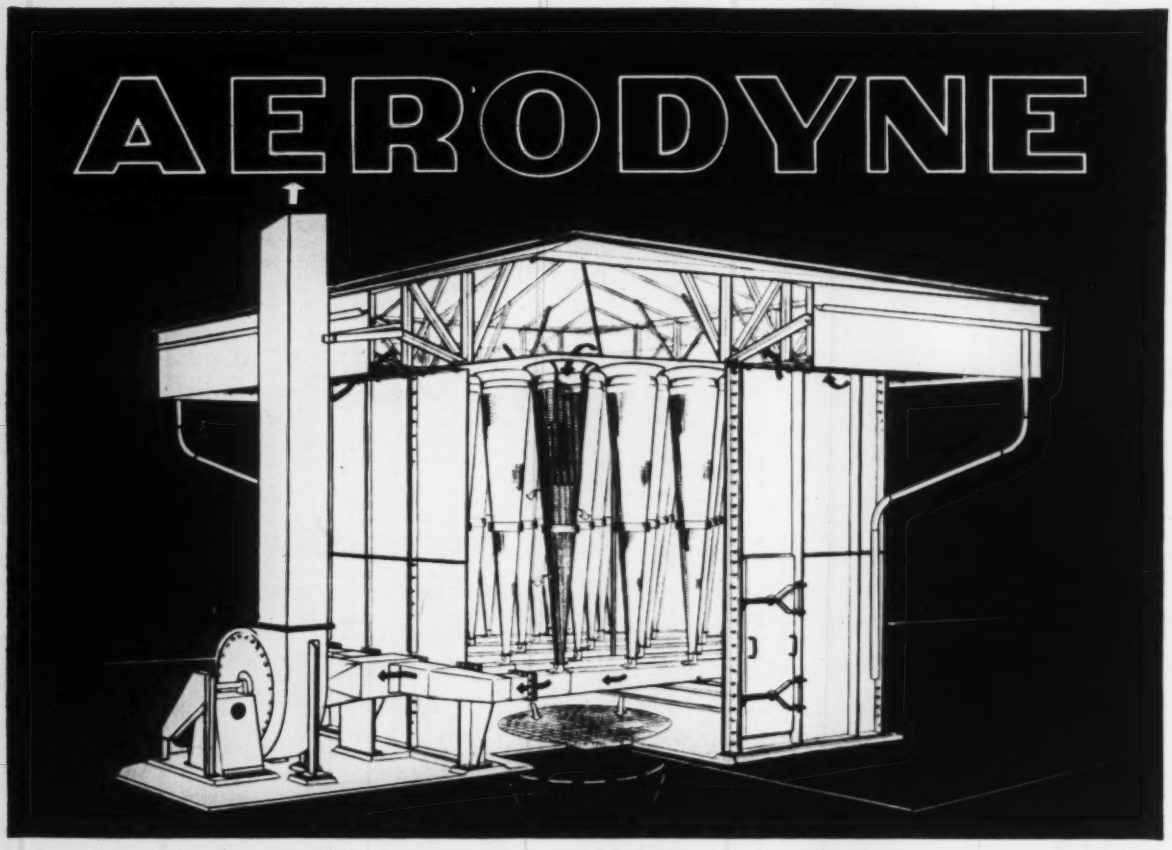

Protects expensive Turbo-Blowers against 'dusty' air

The atmosphere in and around a steel plant can play havoc with turbo-blowers. The air is dusty, carrying large quantities of highly abrasive particles which in a relatively short time cut the blades to pieces.

The Aerodyne is solving this problem . . . as it can in *any* industry faced with dirty air intake to equipment. Installed in a large steel plant, this Aerodyne is extending fan life many times. Formerly, blades were cut down in a few months. Well over a year and a half have now gone by with no sign of appreciable wear.

The story of the Aerodyne in the steel plant is duplicated in many industries. It's a very effective 'dust' remover. We have two descriptive bulletins . . . (1) for Industrial Dust, and (2) for Removal of Fly Ash. In sending for the literature of your choice, we would appreciate it if you would outline your problem. Our reason for asking is that we also make an efficient AIR FILTER, the Econ-O-Roll. It could well be that your requirements call for an air filter rather than a dust collector or perhaps both in series.

THE GREEN FUEL ECONOMIZER CO., INC.
POWER AND PROCESS PLANT EQUIPMENT
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Representatives in Principal Cities

How Much Steam Should a Steam Trap Trap?

. . . some answers to commonly asked questions about the primary job of a steam trap

You don't need a doctor's degree in thermodynamics to answer the question at the top of this page. Naturally, a steam trap should trap *all* the steam.

Unfortunately for you, the problem isn't quite that simple. After all, a shut off valve would trap all the steam . . . and condensate, and air, and carbon dioxide as well.

So we'd better amend the answer to the question this way: A steam trap should trap *all* the steam but *must* remove condensate, air and carbon dioxide as rapidly as they accumulate.

With this established, let's take a closer look at what's involved:

A Steam Trap Should Trap All The Steam

If you've had experience with several different makes of traps, you already know that some trap steam better than others. The operating principle of the trap is what makes the difference. We like to talk about it because Armstrong traps are designed so that no steam can get to the orifice. The valve is always water sealed. Result: *More efficient steam utilization, lower fuel costs.*

A Steam Trap Should Remove Condensate

All traps remove condensate—after a fashion. For maximum efficiency in the unit being drained, though, the trick is to get it out without waiting for it to cool and without leaking steam.

Armstrong's water sealed valve takes care of steam leakage. The inverted bucket operating principle opens the trap for water regardless of its temperature. This means you get the condensate out as quickly as it accumulates. Result: *Higher temperatures and better heat transfer in steam heated units.*

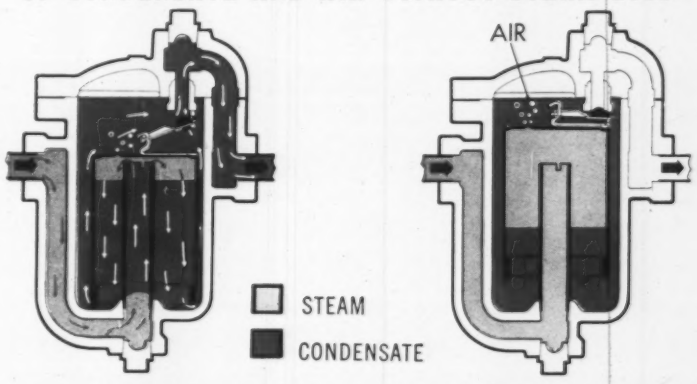
A Steam Trap Should Remove Air and CO_2

Part and parcel of the condensate removal problem is removal of air as well as oxygen and carbon dioxide—two real troublemakers. Air tends to reduce operating temperatures and interfere with heat transfer. CO_2 goes into solution to form corrosive carbonic acid which, for example, can eat unit heater tubes. O_2 aggravates the situation. Believe it or not, but all traps don't properly remove air and CO_2.

By now, you've probably guessed that Armstrong traps *do* remove air and CO_2. Armstrong design (see illustration) provides continuous venting of air and CO_2. By opening suddenly, the Armstrong trap creates a momentary pressure drop to "pump" the air down to be vented. Result: *Higher temperatures, faster heat-up, better heat transfer and reduced corrosion.*

Note: When required, specially sized air vents are furnished. For fast heat-up of low pressure on-and-off units, Armstrong provides open float and thermostatic air vent traps.

HERE'S THE STEAM TRAP DESIGN THAT GETS RID OF CONDENSATE AND AIR WITHOUT STEAM LOSS



Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

What's the Final Answer?

Summing it all up, you'll get the best service from steam heated units that are equipped with traps designed to trap *all* the steam and remove air and condensate as quickly as it accumulates. In our prejudiced viewpoint, this means Armstrong traps. More important are the several thousand users of Armstrong traps who have proved the point.

Before you make up your mind, though, consider the minimum maintenance requirements of Armstrong traps . . . and the convenient assistance your local Armstrong Representative provides. These are important plus values.

Put Up or Shut Up

We're so confident that we "put up". Armstrong traps are unconditionally guaranteed to satisfy. So you can find out for yourself with practically no risk. If you're not completely satisfied with the way they do their job, you can get your money back.

* * *

The 44-page Armstrong Steam Trap book goes into greater detail on these and other Armstrong features. It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write

Armstrong Machine Works
8944 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

Unscheduled fire drill at Carle Place (N. Y.) High School. Building was vacated in two minutes, ten seconds . . . fast, but not as fast as an automatic fire sprinkler system goes to work.

How fire puts itself out

Only two minutes and ten seconds have gone by since the school's bell rang for an unscheduled fire drill.

Everybody's out now. And so would be the fire itself—*in a building where an automatic sprinkler fire protection system stands guard.* This is one certain way to extinguish a fire before it can get anywhere.

Automatic sprinklers today are built to remain pressure tight for years . . . yet designed to respond *instantly* when fire starts.

Certain foolproof materials in their construction hold the key to this performance. Inconel* nickel-chromium alloy valve springs, for example, which one famous maker uses in the sprinkler head.

Regardless of how long they wait in tensed readiness, Inconel alloy springs stay in shape . . . keep their resiliency for trigger-quick response when fire breaks out. And because Inconel alloy resists corrosion under even the severest conditions, the springs provide a lasting, water-tight seal all the time they wait.

By the way, if you would like to have the important facts and information about this nickel-chromium alloy, just ask us for "Engineering Properties of Inconel."

Do you have a metal problem in which corrosion is a major factor? Or wear? Or high temperatures? Or some destructive *combination* of conditions? Then look into the Inco Nickel Alloys. Their properties are described in a helpful booklet called *Standard Alloys for Special Problems.* Write for a copy.

*Registered trademark

The International Nickel Co., Inc.

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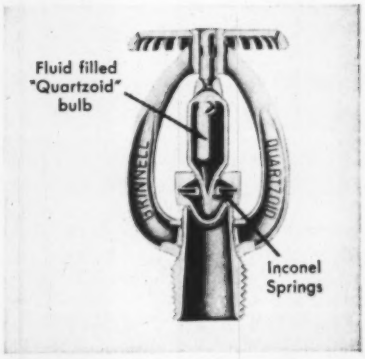

In fire-fighting trim. Cutaway view of automatic sprinkler manufactured by the Grinnell Corporation, Providence, R. I. Fluid-filled "Quartzoid" bulb bursts when temperature reaches danger point. This action releases the tensed Inconel alloy springs that hold the valve closed with 155 pounds load, starts sprinkler system immediately.

INCO NICKEL ALLOYS

NICKEL ALLOYS PERFORM BETTER LONGER

MECHANICAL
ENGINEERING

VOLUME 80 • NUMBER 8 • AUGUST, 1958

Atoms for Peace

A move that would increase the strength and solidarity among the free nations of the World was made recently when President Eisenhower asked Congress for early approval of an International Agreement between the United States and the European Atomic Energy Community (EURATOM). And a wise move it is! For Congressional approval of this agreement will confirm forcibly the position of the United States regarding the use of atoms for peace.

Embracing a one-million-kilowatt nuclear power development, the joint program involves the construction by 1963 in the six EURATOM countries—Belgium, France, The Federal Republic of Germany, Italy, Luxembourg, and The Netherlands—of about six large-scale nuclear power plants based on United States-type reactors.

Since there is a rising demand for electric power in Western Europe, enough electric generating capacity to meet the power requirements of more than five million people in the EURATOM area would be provided through the joint program.

Currently, costs of electric power in Europe are higher than in the United States. Therefore, nuclear power will be economical earlier there than in this country—resulting in an important side benefit: Experience gained through the construction and operation of United States-designed nuclear power plants will be extremely beneficial in accelerating the development of nuclear power in the United States.

In January, 1958, with the President's approval, the United States began to explore the possibility of reaching agreement with EURATOM on a program under which existing utilities in the EURATOM countries would build and operate nuclear power plants using equipment produced in the United States and EURATOM nations.

The program worked out involves a joint research and development effort, availability of enriched reactor fuel from the United States, mutually satisfactory safeguards and controls so that both EURATOM and the United States may be assured of the peaceful purposes of the joint program, and long-term credits to EURATOM.

Establishment and initiation of the co-operative program are subject to several statutory steps of which the International Agreement is the first. Following approval of this Agreement, an Agreement for Co-operation with EURATOM incorporating the details of the plan will be placed formally before the Joint Committee on Atomic Energy. Congressional approval of authorization also will be required for the United States to carry out its share of the joint program.

The competent bodies of the EURATOM Community (the EURATOM Commission and the Council of Ministers) already have taken their necessary statutory actions.

Co-operation with Europe to foster a continuing economic growth has been a major element of United States foreign policy. This joint nuclear power program with EURATOM is expected to provide new horizons for further economic and social advances in an integrated Europe. But even more important, approval of this agreement will demonstrate once again the desire of the United States to harness atoms for peace.—*J. J. Jaklitsch, Jr.*

Editor, J. J. JAKLITSCH, JR.
Editor Emeritus, GEORGE A. STETSON

By F. R. Barnett, Director of Research, The Richardson Foundation, Inc., New York, N. Y.

management and the world struggle

The audience: Power engineers of management caliber. The speaker: A leader in the teaching of citizenship. Here are excerpts from his grim appraisal of our national weakness. If we lose the world competition, we get no second chance.

Unless at least one man out of every three in this room commits himself to an active role in public affairs, then it is unlikely that your business will survive the competition abroad in the world today. This competition is designed to destroy—utterly and for all time—the moral, legal, and political framework of the civilization which undergirds the free enterprise system.

Khrushchev & Company are no longer a rude barbarian horde. They are disciplined in science and well armed with engineering. They are schooled in economics and political theory. They speak many languages. They have learned to use education, literature, art, trade, and even religion as weapons of subversion. Above all, they are superbly trained in the conduct of symbol warfare—in conquest by communication and warfare by words.

The World's Opinion

If the world climate of opinion is mobilized against us by propaganda, we will lose markets, air bases, and access to strategic raw materials. If, here at home, we lose the will to sacrifice, or cynically disregard our spiritual traditions, our physical wealth will not safeguard American civilization. Today, national defense begins at the level of domestic political morality, the quality of citizenship training for our youth, and the reputation of American business growth both here and abroad. These intangibles are the clear responsibility of private citizens.

History teaches us that when a people put indulgence before discipline, worship welfare, and discourage risk-taking, they are likely soon to be forced into bankruptcy by a more vital competition. Especially if they no longer believe in themselves. For nearly twenty-five years this country has been confused by a Cult of Doubt. Too many Americans suffer an odd guilt complex about their own way of life. Meanwhile the missionaries and conquistadors of the Communist Church Militant advance Marxism as the one true faith—and they are willing to die for their belief. That is why the battles of the cold war are fought on our side of the Iron Curtain and at the Kremlin's initiative.

Russia has beaten us into space, produced jet aircraft, and tested guided missiles. A system once contemptuously called the "ox-cart economy" has built the world's second largest navy, graduates more than twice as many engineers as America, and, by ruthlessly disregarding the claims of its consumers, is outproducing us in heavy machine tools, the basic equipment of war.

The Fourth Dimension of Warfare

But the greatest threat to our civilization may not stem from Soviet guided missiles or engineering of atomic weapons. It is in the realm of "fourth-dimensional warfare"—or psychosocial combat—that we are hopelessly outclassed. We know a lot about the tricks and techniques of mass persuasion, but we have not yet applied that knowledge to the main challenge of our time—to beat Communism without fighting a hot war.

The danger of the Russian sputnik is not just that it means Moscow can probably put a missile on New York or, in the near future, aim atomic guns at Pittsburgh and Detroit from a platform in outer space. Sputnik is a symbol of successful Socialism. All over the world, intellectuals and politicians—already half in love with Marx—are saying: "If Socialism can do such wonderful things in science, why not give it another chance with business? If Communism is efficient in the laboratory, let's try it in our factories. If Marxism can plan a sputnik and build so many splendid schools of engineering, we must have social planning and social engineering for every part of our society. Capitalism is obsolete."

The Tongue-Tied American

Despite the record of American enterprise, millions of

Condensed from an address delivered at the American Power Conference, Illinois Institute of Technology, Chicago, Ill., March 26, 1958.

Opinions expressed in this article are not necessarily those of The American Society of Mechanical Engineers.

"...for nearly twenty-five years this country has been confused by a cult of guilt."

"...it is in the realm of 'fourth dimensional warfare' -- or pyschosocial combat -- that we are hoplessly outclassed."

"...politics is the chief business of communism."

"...the ultimate weapon is neither science, politics, nor pyschological war -- but human courage."

"...time is impartial...it is on the side that knows how to use it."

people—including some in this country—will believe that propaganda. Why? Because very few Americans can articulate what it is we really stand for. We perform, but performance is not enough in an age of mass media. The Communists capture the slogans, manipulate the symbols, pervert the communications. The facts are on our side; but facts don't necessarily move men to action. More often, men are motivated by theories, by hopes and hatreds, by envy, fear, or inspiration.

Behind the Iron Curtain there are more than 100 schools and colleges of propaganda and subversion. Many Russians get a first-class education in math, physics, and foreign languages. But other Russians—and selected recruits from Asia, Africa, and Latin America—receive professional training in conflict management and psychological tactics. We have the Harvard School of Business; they have the Lenin Institute of Political Warfare—for politics is the chief business of Communism.

American business cannot afford to be a mere spectator at this match for the future of mankind. The "managers" of Soviet society are all committed to agitation and politics. They are conflict-minded. You can't do business with Moscow, because Communists are not businessmen or statesmen. They are professional revolutionaries. Their foreign aid personnel are commandos; their artists are propagandists, their diplomats are spies; their economy is based on the cost accounting of the battlefield, where every resource is squandered in order to defeat the enemy. If we don't want to fight them—or surrender—we must learn to beat them in the precincts of the Middle East, in the lobbies of the United Nations, in our own classrooms and pulpits, and before the court of world opinion. Our own managers dare not be aloof to this challenge.

If the "business society" is destroyed outright—or simply "withered" by politics and propaganda—business leadership has only itself to blame. After all, every great corporation has more than enough surplus to allow some of its best brains to stop thinking about production and sales and start thinking about national defense, citizenship education, foreign policy, and economic philosophy.

Training Our Own Partisans

One way for business to attack these complex problems systematically—and with sophistication—would be to build an Academy of Industrial Statesmanship. This would be, in effect, the equivalent of the Harvard School of Advanced Management in the area of public affairs, national defense, citizenship training, and the "theology" of American-style Capitalism. Its purpose would be to produce articulate champions of freedom who could compete with the lobbyists for Marx in the never-ending battle to condition the climate of opinion. Also, corporations which give generously to community welfare should switch 5 to 10% of their grants to national survival. . . . (We need) . . . a cultural life-insurance policy on America, in the light of Khrushchev's boast that our grandchildren will live in a Soviet Socialist America.

Ultimately, it may be desirable—even necessary—for great corporations to appoint Vice-Presidents of Public Affairs to spend full time on these matters. A waste of talent? At the beginning of the century, certain firms refused to adopt advertising. They perished. Now, most firms are hospitable to the subtler meanings of public relations. But beyond orthodox public relations lies the arena of public affairs in which the fate of American civilization may well be decided in the next decade.

The Ultimate Weapon

The ultimate weapon is neither science nor politics nor psychological warfare. The ultimate weapon is human courage—and faith in certain unalterable moral laws. Unfortunately, some people have forgotten the true meaning of America. We are already half afraid of the honorable word "revolution," although we are the true revolutionaries. It was an American Revolution that gave the world its finest revolutionary ideal—the notion that government is the servant, not the master, of the people.

Our unique type of Capitalism—almost as different from European Cartel Capitalism as it is from Socialism—produces more welfare and more social justice than Communist functionaries would even dare to imagine. But beyond that is the fact that we are truly free men. We have plenty, and freedom, together. We must not let this remarkable experiment in human liberty and opportunity perish from want of courage, or lack of sophistication, or failure to meet the problem with the ablest human resources at our disposal.

So Few Men Decide the Issue

Forty years ago Communism was confined to a rented room in Zurich, the brains of Lenin, and the ambition of a few other outcasts. Less than 100 men made the American Revolution. For a time the whole future of this nation was carried in the will and heart of a lonely man who walked the winter lines at Valley Forge persuading his ragged countrymen not to quit and go home. There is more than enough talent in this one room to change the course of history. But time is impartial. In politics and war, as in business, time is only on that side which knows how to use it.

COMPUTERS

What They Can Do and How to Speak Their Language

By Victor Paschkis, Mem. ASME, Director,

Heat and Mass Flow Analysis Laboratory, Columbia University, New York, N. Y.

BOTH management and engineers not familiar with large-scale computing devices frequently have misconceptions regarding the possible contribution of these machines.

First and most important: Computers can only provide a numerical answer to one specific set of conditions. Journalistic usage notwithstanding, computing machines are not "thinking machines," if the latter term implies creative thinking. Creative effort must come from man, and no machine can exceed the skill of its designer in the ability to make combinations. Moreover, no computing machine has been invented so far which will yield an analytical solution even to the simplest equation. While the positive statement that computing machines yield numerical answers to given single problems encompasses their entire potentialities, the engineering use of the latter can be grouped into a number of classes, some of which are reviewed here in the sequence of increasing complexity:

1 *Evaluating a given mathematical expression.* If the analytical solution to a problem is given, the evaluation of a given set of conditions frequently can be expedited by computing machines. For example, the thermal stresses for a specific system are described by an equation or set of equations. The numerical values for the given dimensions and conditions can be found with the help of the computer.

2 *Generalizing a solution by development of tables and graphs.* Since analytical solutions cannot be found by means of computers, frequently recurring problems can be solved once and for all by having the computers develop tables. For this they are uniquely qualified, because once a computer is set to solve a single problem, the repeated solution of the same problem with other numerical values is done rapidly and economically. Tables may of course be presented either in tabular or graphic form. Also, based on physical concepts, such tables and graphs can be generalized by dimensional analysis, leading to a number of dimensionless parameters.

One sometimes hears the proposition that most engineering problems are too complex and comprise too many variables to permit representation in generalized form. This is undoubtedly correct but misses the point of usefulness of charts, tables, and the like. Such generalized results necessarily hold for simple conditions which only roughly approximate actual conditions and entail sweeping assumptions. But they offer the possibility of a rapid first estimate, which is frequently all that is done in engineering design.

3 *Determining the relative importance of variables.* No computation by mechanical means (computer) or otherwise can yield results of reliability greater than that of the properties or characteristics used in the computation. Our knowledge of the physical properties of many materials used in industry is still only approximate. Because of their speed of operation, large-scale computing devices can establish a sequence of importance of the several properties and characteristics involved in a process. Calculations can be repeated in a very short time with a number of rather extreme assumptions for the values of several properties. The results show which of them is important.

4 *Exploring several concepts of a device or experiment.* So far, major engineering developments are achieved by invention rather than by analysis. In other words, first solutions to problems usually come by a sudden flash of creative insight—one of the most unexplored facilities of the human mind—rather than by a logical process of elimination of choices. A crude model or prototype of the invention is made. But in order to make this prototype viable it is necessary to understand and interpret logically its functioning. How often does one hear: "It works, but I don't know why"? This understanding can be greatly helped by large-scale computers.

The engineer or scientist looking at an invention may conceive of several concepts which could explain the behavior of the invention. The computer can translate these concepts into specific numbers, which can be compared with measurements on the prototype. The set of numbers checking best with the measurements discloses the one concept which is probably valid.

For example, in a certain chemical process a reaction vessel was designed, requiring a specific source of heat and cooling; exothermic and endothermic reactions take place. But it was not clear how the heat sources were distributed. Several assumptions were made, and based on these assumptions vessel temperatures, and so on, were computed; one—and only one—set of assumptions led to results coinciding with measurements. Thus the most probable concept of the process was established.

5 *Scaling up of processes.* It is customary to try out new processes on a pilot-plant scale—or frequently even a smaller one. Designing a full-sized piece of equipment based on such small-scale models poses a number of problems sometimes of formidable size. The several branches of physics and chemistry underlying a process may require different scale factors. This scaling up can be greatly helped by large-scale computers. If the process on the small scale can be described adequately by a computer, extrapolation is made easier. The computer readily allows introduction of different scale

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factors for the different parts of a process, resulting finally in the appropriate design.

Exactly this was the procedure used in the case mentioned in the preceding section. Based on the "concept" selected by analysis of the small-scale models the design of the next larger size was established. Analysis of performance checked closely with predictions based on computations. This led to the next larger size, and so on.

"Language" Problems

Large-scale computing machines have a language of their own. If they are to solve problems, they must receive instructions in a language which they understand. Frequently more than one translation is required. To explain this the following definitions are used: "The process" is the point of origin for the problem, which may have many facets, that is, kinematic, thermal, stress, and so on. Each of these facets is called a "field." By way of example consider the continuous electric welding of a tube. The process involves the temperature distribution, problems of plasticity, power generation, and electrical problems—depending on the nature of the welding machine. The over-all problem of, say, increasing the output of the machine must be translated from the language of the welding engineer (process) into that of the several disciplines or fields (heat transfer, plastic flow, and the like).

Each of the problems in the several fields must now be solved. If this is done on a computing machine the field language (heat transfer and the other fields) must now be translated into machine language. Best translations of books are achieved by the co-operation of two translators, one having the language of the original text as mother-tongue, and the other the language of the translation. Similar conditions exist in computing laboratories, and the illustration of partially overlapping rings seems to express this need. Thus one arrives at a sequence as shown in Fig. 1.

Laboratory Organization

While the number of processes according to the present definition is very large, that of fields is much smaller. Thus while it is impractical to have all processes represented on a computer-laboratory staff, it is not beyond reach to have the majority of fields represented. It is, however, imperative that the "fieldmen"—used here in the sense of specialists in the several fields—be conversant with: (*a*) As many processes as possible; (*b*) all types of computers available in the laboratory in question.

Since the fieldmen are the only ones in the foregoing scheme who "speak three languages"—process, field, and computer—they are obviously the key people in the group. Most computer laboratories will have no process men on their staff, expecting rather the "customers" to contribute this part.

In view of the mathematical language of the computer, mathematicians obviously are required. But while the computer language is mathematical, the computer is mostly an electrical tool, and hence electric or electronic help is required. Thus field people, mathematicians, and electrical engineers are needed. In the experience of the Heat and Mass Flow Analyzer Laboratory the mathematical and electrical experts function best in a "staff capacity." They are available for consultation but are not involved in the normal processing of problems. Omitting administrative personnel, the setup starts with the fieldman who, on the basis of conversation with the process man, formulates the problem and translates it into general computer language. The coder gives the computer detailed instructions. The operator actually operates the computer and returns the result to the fieldman for interpretation, Fig. 2.

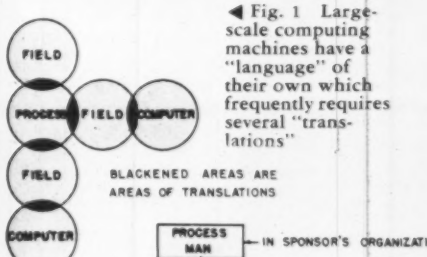
The simplicity of the scheme should not mislead. The "coding" operation frequently involves a number of steps which may even require different skills. If one may extend the metaphor of the interpreting functions, the computer, though understanding mathematical language, may be conversant in only one dialect. Thus coding may involve translation from the classical mathematical language into the machine dialect. Auxiliary personnel for maintenance are not shown in Fig. 2. The fieldman can call on the help of the mathematician and electronics man.

Social Implications of Automation

Automation must result in increased leisure and or the increased use of gadgets. Both alternatives present serious social problems—in the long range. While it is not and cannot be the function of the engineer to solve them, it behooves him to state these problems, particularly when they issue from his work.

The specter of unemployment is frequently raised in connection with automation, but technological unemployment can be turned into increased paid leisure if the necessary social inventions—the "gadgets" that will replace human effort—and the proper key for increasing the pay scale are found. Increased leisure has been the dream of mankind for thousands of years, but is something that should be used creatively because creativity in its broadest sense is man's noblest calling.

While relief from physical work and the drudgery of life may at first enhance human personality, there may be an optimum beyond which human deterioration sets in. The present trend to use leisure passively rather than actively and creatively may be the beginning of a downward trend of civilization if we do not seek constructive solutions to the problem of increased leisure.



◀ Fig. 1 Large-scale computing machines have a "language" of their own which frequently requires several "translations"

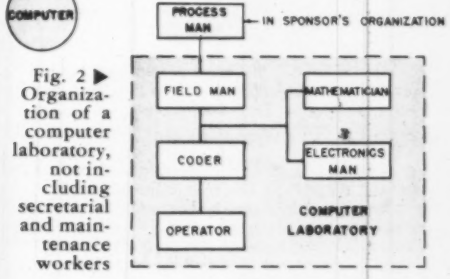


Fig. 2 ▶ Organization of a computer laboratory, not including secretarial and maintenance workers

Today, safety of flight is more than sound structural design: It depends on complex mechanical, hydraulic, pneumatic, electrical, and electronic systems. The designer needs information he never had before, in order to be able...

TO BEAT THE "COMPLEXITY" BARRIER

By J. de S. Coutinho,[1] Mem. ASME
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As we advance into new flight regimes with untried configurations costing hundreds of millions of dollars, each prototype requiring the efforts of many hundreds of designers and involving equipment requiring years of lead time, the cost of the traditional development process is becoming astronomical.

New equipment is always developed on a trial-and-error basis. No inventor has ever been smart enough to visualize his invention in its final form. The long period of debugging often requires as much ingenuity, time, and effort as the original design. In aviation, we must find methods of doing more and more of our debugging in advance.

Moreover, at today's higher speeds and altitudes, operational requirements which, in the past, have eluded analytical treatment and control, are becoming major stumbling blocks in the way of progress. Environmental conditions cannot be predicted accurately. Even when the conditions are known, it is often technically or economically impossible to reproduce them in the laboratory.

Design Requirements

Tests, therefore, tend to be designed on the basis of what can be measured rather than what should be measured. Design requirements are often based on what can be tested rather than on the operator's actual service requirements. Furthermore, in military aviation, as soon as something new is developed, new uses are invented for the new equipment and the equipment is never quite satisfactory for the unforeseen uses.

On a project involving hundreds of designers, all of whom are concerned with the integrity of the design, each designer arrives at decisions on the basis of an intuitive evaluation of his personal experience, guided by "common sense." In many cases, no two designers will make the same series of decisions. As a first goal, it seems desirable to develop systematic and objective methods of applying the full weight of all the accumulated experience and ability of the group to the formulation and co-ordination of every key decision.

In structural airframe design, dependable methods have been developed for determining all basic parameters for applied loads, strengths of materials, and load distribution throughout the structure. They result in a minimum of debugging after construction. New and complex airframe configurations are developed almost as a matter of routine. The major engineering effort is concentrated on the initial design of the airframe structure.

This situation does not exist in the design of power-operated primary flight-control systems and many other systems associated with high-speed flight. Little basic information is available regarding operational-load spectrums, the control of friction and wear, or the prediction of service and endurance life.

Failure-Effect Analyses

The requirements being established [1, 2, 3][2] by Naval aircraft procuring agencies for failure-effect analyses represent a first step. This type of analysis is known by

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[2] Numbers in brackets designate References at end of paper.

TABLE 1 RELIABILITY ANALYSIS

Configuration	Item		Reliability P	Failure Rate ω
Combined (See Fig. 1)	1	Flight System	.99976	.00024
	2	Combined System up to Isolation Valve	.99952	.00048
	3	Combined System beyond Isolation Valve	.99927	.00073
	4	Reliability of Items 1 and 2	.99999885	.00000115
	5	Availability of Items 1, 2, and 3		.00115
Independent (See Fig. 2)	1	Control System #1	.99976	.00024
	2	Control System #2	.99976	.00024
	3	Utility System	.99895	.00105
	4	Reliability of Items 1 and 2	.99999424	.00000576
	5	Availability of Items 1, 2, and 3		.00153

NOTES: 1. Reliability: $P_4 = 1 - \omega_4$ where $\omega_4 = \omega_1 \times \omega_2$

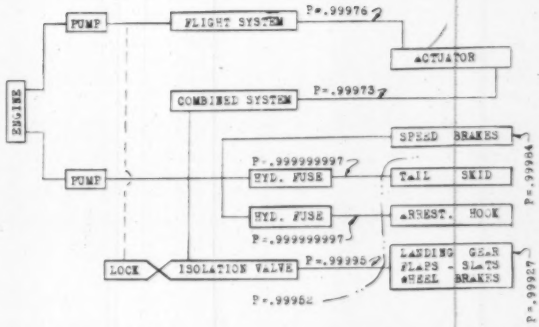
2. Availability: $A = 1/\omega_5 = 1/(\omega_1 + \omega_2 + \omega_3)$

3. Increase in Reliability, Independent Configuration over Combined Configuration:

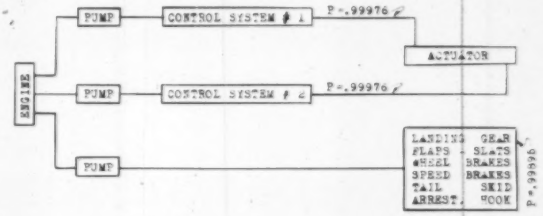
$$P_4 = \frac{.99999942_4 - .99999885}{.99999885} = .00000057, \text{ say approx. } .00006.$$

4. Increase in Availability, Combined Configuration over Independent Configuration:

$$\omega_5 = \frac{.00153 - .00115}{.00153} = .2484, \text{ say approx. } 25$$



▲ Fig. 1 One flight system and one combined flight-and-utility system. What is the "availability" of the combination?



▼ Fig. 2 Two flight systems and an independent utility system. Does this combination have greater, or less availability?

different names, such as failure analysis, malfunction analysis, or reliability analysis; but the term failure-effect is preferred here because the analysis is primarily concerned with the effect of assumed failures.

The key operation in a failure-effect analysis is the selection (i.e., prediction) of the critical conditions and possible failures. No satisfactory objective methods have yet been developed to insure that all critical conditions and all possible failures have been duly considered. We have a systematic approach, some basic principles, but no generalized mathematical formulas. The process is highly intuitive.

By specifying the conditions and failures which must be investigated, as is done in [3], the responsibility for their selection is transferred from the manufacturer to the procuring agency. This method provides a greater opportunity to exploit past experience, but still does not guarantee that all failure possibilities have been considered.

Reliability and Availability

The systems designer is often faced with the problem of designing reliable systems consisting of components which are, to some extent, unreliable. Here, the designer usually duplicates the system one or more times, either with parallel continuously operating systems, or with parallel stand-by systems with decision devices to trigger them when the main system fails. The designer must decide how much redundancy is required.

Improving reliability in this manner means the addition of components and weight to the system, which in turn increases the supply and maintenance problems and lowers availability. We hope to establish a quantitative correlation between reliability and availability, and we believe that some day it may be practicable to specify availability at a known level of reliability, rather than reliability alone.

If acceptable reliability cannot be achieved at reasonable levels of availability, a complexity barrier will have been reached, challenging the systems designer to invent new methods of break-through.

Reliability Analyses

For evaluating competing proposals, we use a quantitative reliability analysis. The following generally accepted definitions are based on [4]: *Reliability* is the probability that no failure will occur which will prevent the completion of a successful mission of standard duration:

$$P = 1 - Q$$

where P = reliability

$$Q = \frac{\text{number of breakdowns}}{\text{component flight hours}} = \text{failure rate}$$

The failure rate is assumed to equal the probability of failure.

A configuration consisting of parallel systems 1, 2, . . . , will fail only if there is simultaneous failure in each of the parallel systems:

$$P = 1 - (Q_1 \times Q_2 \times \ldots)$$

We have no satisfactory definition for *availability*. Reference [6] uses the term "operational readiness," and defines it as the probability that a system will perform satisfactorily at any point in calendar time, and suggests that the percentage of "up time" is synonymous with operational readiness. It points out that operational

TO BEAT THE "COMPLEXITY" BARRIER

readiness depends upon both the reliability of the system and the speed with which it can be restored after failure.

Lacking the figures for up time, it is assumed here that, since all replacements must be accomplished before the aircraft can take off, and that the availability A is inversely proportional to the replacement rate Q_R:

$$A = 1/Q_R$$

The procedure is shown in Figs. 1 and 2, comparing two competing primary flight-control systems for a single-engine military aircraft. Table 1 shows that the Combined Configuration is 5 per cent more available than the Independent Configuration, with negligible decrease in reliability. A weight study shows that the Combined Configuration weighs 170 lb less than the Independent Configuration.

Sources of Trouble Data

The basic data for reliability studies are based on empirical failure and replacement data taken from flight and laboratory tests and from trouble records received from operating activities.

Knowledge of service operating conditions is obtained at Grumman through the Service Department which maintains continuous contact with all major U. S. Naval Aviation Commands and intermittent contact with all Naval Aviation operating units. All reports are screened by the engineering department for material failures which may yield information on environmental conditions or design requirements.

The most comprehensive system of obtaining operating trouble reports is the Naval Aeronautical Material Reliability Program established by reference [5], which directs all Naval Aviation operating units to report every failure, replacement, or unsatisfactory condition as it occurs on one of two simple forms: the FUR (Failure, Unsatisfactory, or Removal form) or the EFR (Electronic Failure Report). The information is reproduced on machine cards. If the reports are "amplified" by description or photographs (AMPFUR), this material is reproduced on microfilm mounted on a supplemental card. FUR's are classified in four categories: FUR, Class O; AMPFUR, Class 1; URGENT AMPFUR, Class 2; and SAFETY-OF-FLIGHT-AMPFUR, Class 3. Duplicate cards are made available to the manufacturer. Failed parts may be released to Naval laboratories, or to manufacturers, for pertinent investigations.

Processing of Reports

Each trouble report, FUR or other source, is recorded on an individual Grumman Failure Machine Card. A great deal of effort has been spent on the method of filing Failure Cards. The difficulty arises out of the large bulk and diversified nature of the information being handled. The basic concept is to file Failure Cards by aircraft model and part numbers. But trouble reports refer not only to Grumman-manufactured parts but also to parts purchased from hundreds of vendors, each with his own number system. Many interchangeable parts come from alternate sources, and each vendor will have his own number for the same part.

These and similar technical factors led to the establishment of an "Account" numbering system. The Account Number is a six-digit number designed for ease of machine processing in which the six digits classify the item by group and nature—and finally identify the item itself. An "item" may be a part, an assembly, an aircraft system, or a system of account numbers.

Since an AMPFUR reports a condition which cannot be adequately described by a simple precoded checkoff list, a "phrase" is prepared for each AMPFUR on one or more appended Phrase Machine Cards, giving a brief description of the trouble and its cause, references to other sources of information, or to records of corrective action, and to similar pertinent data. A similar procedure is followed for all other trouble reports which cannot be completely recorded on a Failure Card. The present system is designed to encompass every type of trouble report except Electronic Failure Reports (EFR) which are subjected to separate studies.

Using the Trouble Data

Failure histories. Failure histories consist of printed IBM runoffs of the Failure and appended Phrase Cards for selected account numbers. They are prepared immediately upon individual request for any member of the engineering department.

Periodic group runoff. At intervals, a complete runoff is prepared for each engineering group, listing by aircraft model and account number:

1 AMPFURS and appended Phrase Cards.

2 "Other" trouble reports and appended Phrase Cards which include references to any available records of corrective action.

3 For each account number, the total number of reports received.

Monthly statistical review. This is a formal report which lists the following statistics: For the current month: number of FUR's received by airplane model and FUR class, number of reports routed to project engineers for investigation; for all previous months: number of FUR's received for each month by FUR class.

Current reports contain experiments with control charts and other statistical techniques in an attempt to develop a presentation which monitors incoming data for incipient trouble areas and establishes a more effective contact between the design engineer and operator.

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2 Military Specification MIL-D-8706(Aer), Contract Requirements for Aircraft Design Data (20 April 1955), para. 3.2.5.11(e). Bureau of Aeronautics, Department of the Navy.

3 Special Aeronautical Requirement SAR-317, Reliability Analysis For Controls for Aeronautical Gas Turbine Power Plants, Bureau of Aeronautics, Department of the Navy.

4 R. R. Carhart, "A Survey of the Current Status of the Electronic Reliability Problem." Research Memorandum RM-1131, The Rand Corporation, Santa Monica, Calif.

5 BuAer Instruction NAVAEROO.58B, Naval Aeronautical Material Reliability Program, Bureau of Aeronautics, Departt of themen Navy.

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BERYLLIUM MACHINING CHARACTERISTICS

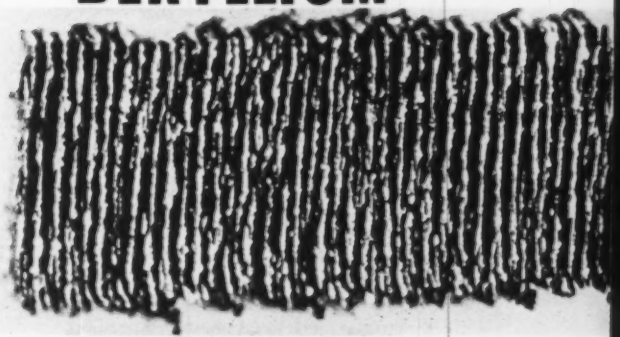

Fig. 1(*a*)

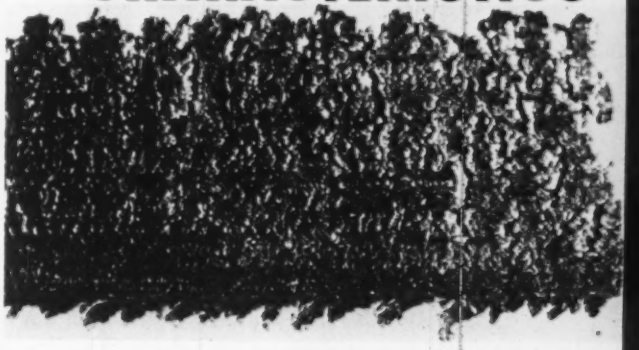

Fig. 1(*b*)

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Beryllium is a metal possessing a remarkable combination of properties. It exhibits an elastic modulus 40 per cent higher than steel, a strength-weight ratio 30 per cent greater than titanium, a density comparable to magnesium, roughly 40 per cent of the electrical and thermal conductivities of copper, and the relatively high melting point of 2345 F [1, 2].[1] These properties could easily establish beryllium as a true "wonder metal" were it not for its brittleness, toxicity, and high cost. Beryllium, currently most used in x-ray windows, neutron sources, and moderators, and as an alloying element in copper, may become an important structural material for aircraft and related uses if cost and lack-of-ductility problems can be solved.

Beryllium is readily machined, but special precautions and procedures must be observed to avoid health hazards due to the toxicity of the metal and its compounds [3]. Cutting fluids should be avoided whenever possible to permit easy collection and evacuation of chips by a vacuum system and to prevent contamination and devaluation of the chips as scrap.

Qualitative Observations of the Machining Process

Beryllium-machining chips are generally partially continuous consisting of discontinuous segments which reweld to each other after separation. The chips are thus extremely brittle and easily broken. When machining is done at extremely high or very low speeds, or when tools having low or negative rake angles are used, chips are sometimes completely discontinuous. The side of the chip, Fig. 1(*a*), which has not been in contact with the tool shows the partially continuous nature of the chip.

The side of the chip which has been in contact with the tool does not have the burnished, shiny appearance found when cutting many conventional materials, but is instead extremely rough and contains many cracks. This rough surface is caused by a stick-slip phenomenon and the periodic formation and breakdown of a built-up edge on the tool point. At speeds above about 300 surface feet per minute (sfpm), the tendency for built-up-edge formation diminishes, and both work and chip surface finish improve.

Photomicrographs of typical beryllium chips, Fig. 2, show that chip formation is primarily a brittle process. Many partially rewelded cracks can be seen. Some plastic flow and twinning can be observed, particularly on the sides of the chips that were in contact with the tools. Roughness produced by stick-slip motion of the chip along the tool face is also evident.

[1] Numbers in brackets designate References at end of paper.

Contributed by the Production Engineering Division and presented at the Semi-Annual Meeting, Detroit, Mich., June 15-19, 1958, of The American Society of Mechanical Engineers. ASME Paper No. 58—SA-43.

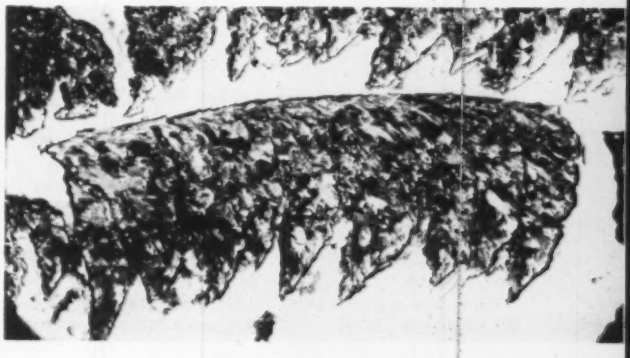


Fig. 2

Fig. 1 Typical beryllium chip (×20): (*a*) Side of chip not in contact with tool; (*b*) side of chip which passed along tool.

Fig. 2 Typical chip photomicrograph (×100): tool, high-speed steel; speed, 140 sfpm; depth, 0.100 in.; feed, 0.0104 in.

Fig. 3 shows a typical beryllium surface produced by machining. The surface looks quite similar to the tool side of chips, Fig. 1. Its scuffed appearance is caused by stick-slip friction and the adherence of portions of built-up edges to the work. In general, machined beryllium surfaces improve in appearance and in smoothness with increasing tool rake angle. Rockwell hardness tests made on machined surfaces show no significant variations with tool rake angle or depth of cut.

Turning cuts have been made at depths as high as 0.100 in. and with feeds as high as 0.015 in. Tungsten-carbide, Carboloy 44A tools having side rake angles as high as +20 deg and high-speed steel (HSS) tools with side rakes up to +35 deg have been used without tool chipping. Cutting conditions appear to improve steadily with increasing rake angle. Carbide tools have been operated for short times at speeds up to 1000 sfpm, and HSS tools have been used at speeds as high as 300 sfpm without immediate failure. Ceramic tools of standard negative-rake geometry have also been used successfully.

Photographic Study of Cutting Process

A motion-picture study of extremely slow-speed beryllium machining was made with a reflex type, 16-mm camera using a 1-in-focal-length lens and a 10-in. lens extension. A milling machine was used to achieve a planing action with cutting speeds less than 2 in. per min. Cutting phenomena were recorded as functions of tool rake angle, depth of cut, and cutting fluid. An edited film summary of approximately 10-min duration was prepared.

The films of slow-speed beryllium machining showed that chip formation was discontinuous, but that chip segments tended to stick together to form a partially continuous chip. Chips were formed partly by conventional plastic shear but mostly by a brittle-type, splitting action. Surface crack formation was observed. Friction between chip and tool appeared high at the low speeds used, and a stick-slip action was seen. Frequent formation, destruction, and reformation of a built-up edge were evident, as was the effect of such a built-up edge on chip formation and surface finish. Use of high rake angles and low depths of cut was seen to improve the cutting action and resultant surface finish. Use of carbon tetrachloride as a cutting fluid seemed to have had little or no effect on the cutting process.

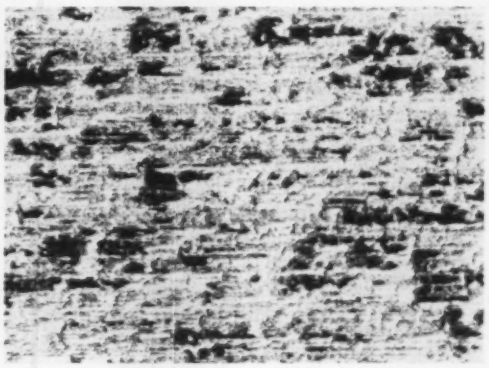
A photographic analysis of beryllium machining at normal cutting speeds was made with a still camera using a 32-mm-focal-length lens and a 19-in. lens extension. Four xenon spark tubes were used as a light source to produce an effective exposure time of less than 2 microsec. The camera and light source were mounted on the cross slide of a lathe and moved with a tungsten-carbide tool as the tool was fed radially into a 3-in-diam beryllium "spool."

Representative photographs made with the above technique are shown in Fig. 4. These "static" pictures of beryllium behavior at speeds normally used in machining showed substantially the same phenomena as the motion-picture studies of slow-speed machining. The fine dust particles which must be evaluated safely also were seen. Completely plastic, continuous chip formation was not observed in the range of speeds used (50–600 sfpm).

BERYLLIUM MACHINING CHARACTERISTICS

▶Fig. 4 Spark pictures of beryllium machined with tungsten-carbide tool (×75)

▼Fig. 3 Beryllium surface after machining (×45).



Tool, Carboloy 883; speed, 110 sfpm; depth, 0.002 in.; feed, 0.009 in.

Surface Damage by Machining

A study was made to determine the influence of machining depth of cut on surface damage. According to information available at the time Avco began to fabricate beryllium products, surface cracks approximately equal to the depth of cut were caused by machining operations. It was speculated that such cracks, formed by a roughing-type operation using a large depth of cut, might propagate to greater depths if subsequent operations of comparable severity were used.

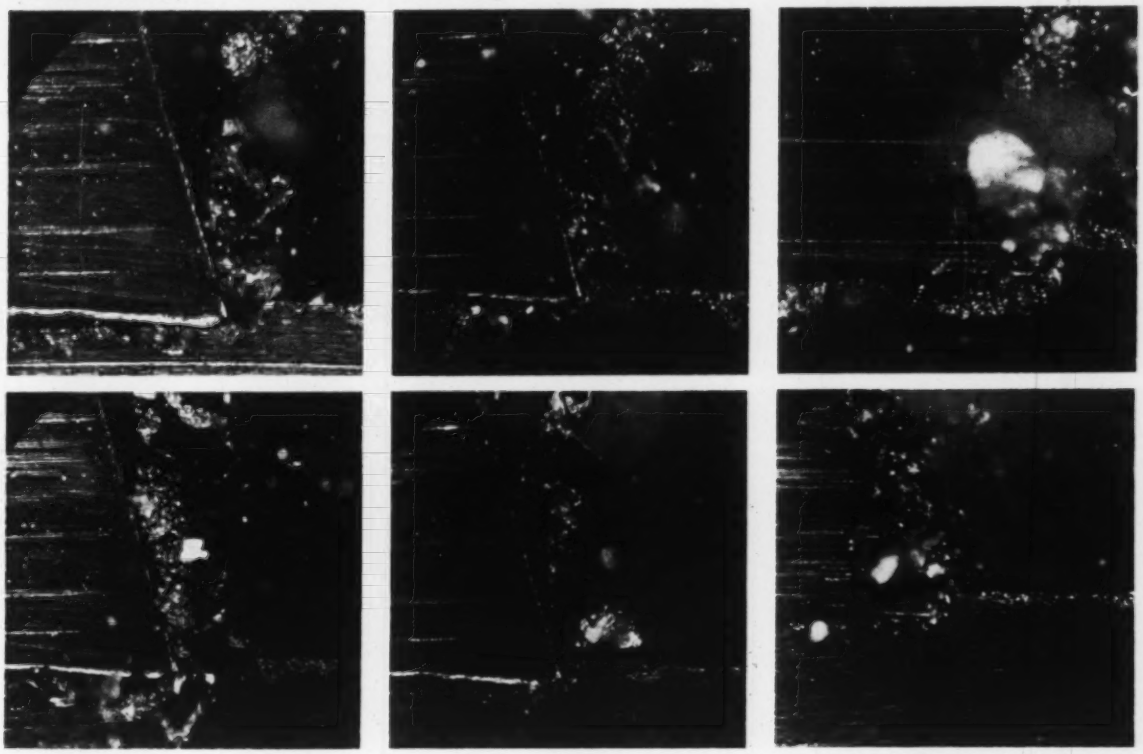
A specimen surface was produced on QMV beryllium using a conservative "safe" procedure, consisting of consecutive passes of decreasing severity having depths of 0.124 in. (using a "step" tool having 0.062-in. steps), 0.062, 0.032, 0.015, 0.010, 0.005, and 0.002 in. A second specimen surface was prepared by a far more severe procedure which used a depth of 0.186 in. (using a step tool with 0.062-in. steps and accompanied by severe tool chatter) followed by finish cuts having depths of 0.005 and 0.002 in. Low-powered optical microscopy (up to ×45) and Zyglo inspection did not reveal surface cracking on either specimen and showed no important differences in surface characteristics.

Electron-microscope examination of the two specimens in the as-machined state revealed numerous surface cracks in both specimens but no significant difference in the number or apparent severity of the cracks.

(*a*) Tool rake angle, 15 deg; cutting speed, 280 sfpm; depth, 0.006 in. *Note* local plastic flow at tool point and surface crack behind tool.

(*b*) Tool rake angle, 15 deg; cutting speed, 280 sfpm; depth, 0.005 in. *Note* surface cracks and discontinuous portions of chip.

(*c*) Tool rake angle, 15 deg; cutting speed, 180 sfpm; depth of cut, 0.012 in. *Note* crack forming at the point of the tool.



(*d*) Tool rake angle, 15 deg; cutting speed, 220 sfpm; depth of cut, 0.007 in. *Note* chip about to crack away from work.

(*e*) Tool rake angle, 15 deg; cutting speed, 240 sfpm; depth of cut, 0.006 in. *Note* intermittent plastic brittle chip formation.

(*f*) Tool rake angle, 25 deg; cutting speed, 240 sfpm; depth, 0.006 in. *Note* improvement in chip uniformity at this higher rake angle.

Further examination of the specimens after chemical removal[2] of 0.001 in. from the machined surfaces showed similar results. However, chemical removal of a total of 0.002 in. from the machined surface eliminated the cracks on both specimens, thus indicating that surface cracks were not of depths comparable to the depth of cut in heavy cuts, and that a slow, safe machining procedure was unnecessary. Typical electron photomicrographs of surfaces in the as-machined and chemically polished states are shown in Fig. 5.

Beryllium-Oxide Content of Chips

The beryllium-oxide content of beryllium-machining scrap affects the value of the scrap for reworking purposes. To determine the influence of tool geometry and cutting speed upon the increase in beryllium-oxide content of QMV beryllium scrap, a series of chip specimens was obtained, using a Carboloy 44A tungsten-carbide tool, a depth of cut of 0.100 in., and a feed of 0.005 in. per revolution.

The beryllium-oxide contents of the chip specimens are shown in Fig. 6. The average beryllium-oxide content for all samples as shown, was 1.37 per cent compared to an original beryllium-oxide content before machining of 1.27 per cent. The standard deviation of all data about the average beryllium-oxide content was 0.07 per cent as indicated by the dotted lines, which should envelop an average of 68 per cent of all data if beryllium-oxide content is independent of cutting speed and tool geometry. Fig. 6 shows that the beryllium-oxide content of cutting chips was not a strong function of either cutting speed or tool geometry. Also, it may be seen that machining raised the beryllium-oxide content of QMV beryllium by only about 0.1 to 0.2 per cent.

Cutting Temperatures

The average temperature at the chip-tool interface during machining was measured by using a tungsten-carbide tool and the beryllium chip as the two dissimilar metals of a thermocouple. Temperature measurements were made as functions of cutting speed and cutting feed in a turning operation. The tool was insulated electrically from the lathe and was connected to one terminal of a recording oscillograph. A second lead was connected to the workpiece and thence to the oscillograph through a mercury commutator.

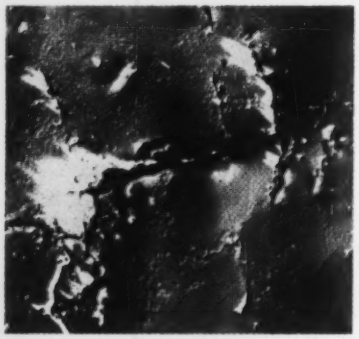
A temperature-electromotive-force (emf) calibration for the beryllium-tungsten-carbide thermocouple was made, using a Cerrocast metal bath which was heated with an oxygen-acetylene torch. A long, thin section

[2] Chemical polishing was done with a solution consisting of 6.6 per cent CrO_3, 76.1 per cent H_3PO_4, 5.5 per cent H_2SO_4, and 11.8 per cent H_2O (by weight).

BERYLLIUM MACHINING CHARACTERISTICS

Fig. 5 Electron photomicrographs of machined beryllium surface (×2000)

(*a*) As machined



(*b*) After chemical removal of 0.001 in.

(*c*) After chemical removal of 0.002 in.

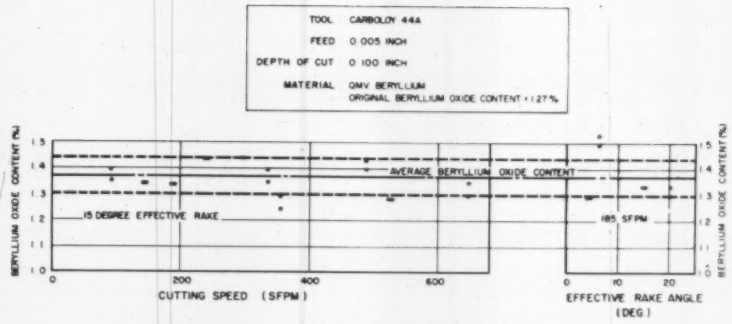


Fig. 6 Beryllium-oxide content of machining chips versus cutting speed and effective tool rake angle

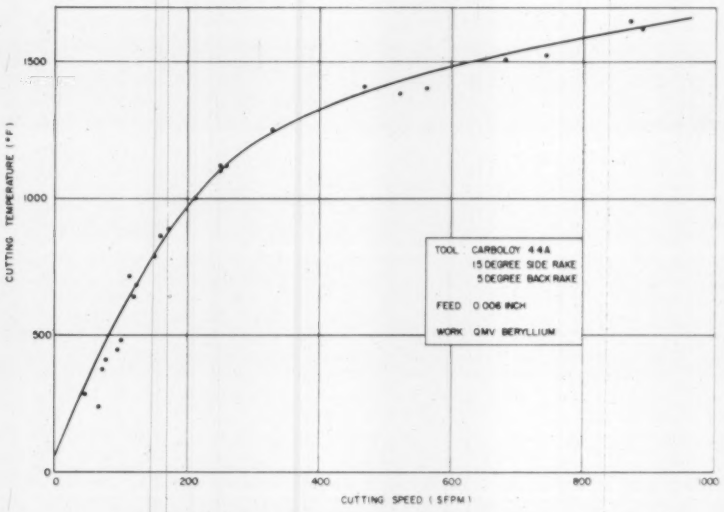


Fig. 7 Chip-tool interface temperature versus cutting speed

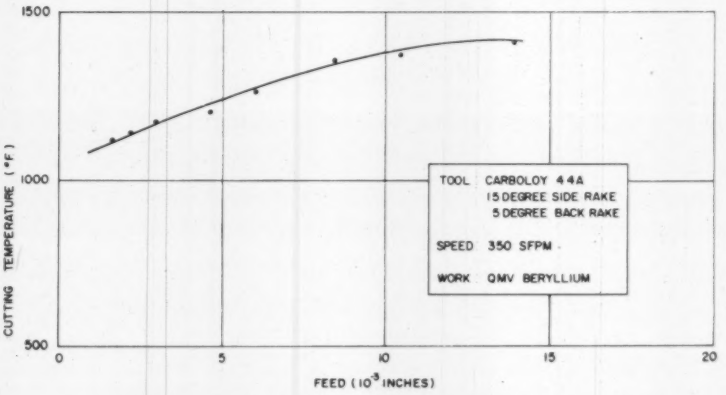


Fig. 8 Chip-tool interface temperature versus feed

Table 1 Values of Cutting Speed Required to Produce Various Chip-Tool Interface Temperatures Using Tungsten-Carbide Tools and 0.006-in. Feeds[a]

Chip-tool temperature, deg F	Beryllium, sfpm	Titanium RC130B, sfpm	18-8 stainless steel, sfpm	SAE 1015 steel, sfpm	SAE (B1112) steel (free machining), sfpm
800	150	20	100	90	280
1000	210	45	150	150	450
1200	300	110	230	270	620
1400	500	240	450	..	..
1600	850	760	820	..	..

[a] Additional data from references [4] and [5].

of beryllium taken from the test billet was immersed in the metal bath together with a tungsten-carbide rod, consisting of tool bits brazed together. A standard, chromel-alumel thermocouple also was immersed in the bath. The chromel-alumel and beryllium-tungsten-carbide emf's were plotted simultaneously by the recorder as the bath was heated and cooled.

Fig. 7 is a plot of chip-tool temperature as a function of cutting speed at a feed of 0.006 in. Fig. 8 shows the variation of temperature with feed at a constant speed of 350 sfpm. As in machining most materials, cutting temperature is much more strongly dependent upon cutting speed than upon feed.

Table 1 shows the approximate cutting speeds for various tool-chip interface temperatures for several materials. Tool-chip temperature strongly affects tool life, especially at high temperatures, since tool wear is accelerated with the decrease in tool hardness which accompanies increasing temperature.

Cutting Forces

A limited amount of cutting-force data,[3] obtained with tungsten carbide and ceramic tools, is shown in Table 2.

The coefficients of friction of Table 2 are remarkably low, especially in view of the considerable built-up-edge formation and stick-slip friction observed in photographs of the cutting process and in chip photomicrographs at the conditions of Test No. 1. The apparent anomaly might be explained by the brittleness of beryllium which would allow easy fracture of friction welds; however, further study of beryllium-tool friction is required.

Tool Life

The life of tungsten-carbide tools in machining QMV beryllium has been evaluated as a function of cutting speed and feed for finish-type cuts, using feeds less than 0.010 in. Tool wear is usually determined by measuring the rate of growth of the flat or land which is generated on the clearance or flank face of the tool; Tool life generally is defined as the time required to produce a wear land of a given thickness. In the tests described here, wear lands of 0.010 and 0.015 in. have been used as tool-life criteria.

The wear land on the clearance face of tungsten-carbide tools grows quite regularly and uniformly in beryllium machining. Wear of the cutting or rake face of the tools (cratering) is not severe. Fig. 9 shows the clearance and rake faces of a Carboloy, grade 44A, tungsten-carbide tool with a uniform 0.015-in. wear land. This tool has been operated at 290 sfpm for 124 min.

[3] Data were obtained in co-operation with Professors M. C. Shaw and P. A. Smith and Mr. C. Christiansen of the Massachusetts Institute of Technology.

Table 2 Beryllium Cutting Forces[a]

Test	Tool	Cutting speed, sfpm	Power force, lb	Feed force, lb	Coefficient of friction	Specific energy, psi × 10^{-5}
1	Tungsten carbide (Kennametal K6)	130	430	156	0.23	4.1
2	Same	320	400	115	0.16	3.8
3	Same	610	390	130	0.20	3.7
4	Same	1010	400	144	0.23	3.8
5	Ceramic (Stupakoff)	320	440	160	0.23	4.2
6	Same	990	400	150	0.24	3.8

[a] Tool Geometry: −7 deg side rake Feed: 0.0104 in.
−7 deg back rake Depth: 0.100 in.

Note: Values of specific energy and friction coefficient shown in Table 2 are approximate since only two force components were measured and chip widths were not determined.

Fig. 10 is a plot of cutting speed versus tool life (0.010-in. wear land) for beryllium machining with Carboloy 44A tungsten-carbide tools. Metal-cutting wear data usually can be made to fit the empirical relationship

$$VT_L^A = B$$

where V = cutting speed, sfpm
T_L = tool life, min

The data of Fig. 10 fit the above equation as shown by the line drawn according to the relation

$$VT_L^{0.18} = 680$$

If an 0.015-in. wear land is used as a definition of tool life, the constant B in the equation becomes 770. Preliminary wear data obtained with Carboloy 883 tools (a harder, more wear-resistant grade of tungsten-carbide) indicate that the constant A in the equation remains unchanged while B becomes 760 for a tool life defined by 0.010-in. wear land or 860 for an 0.015-in. wear-land life.

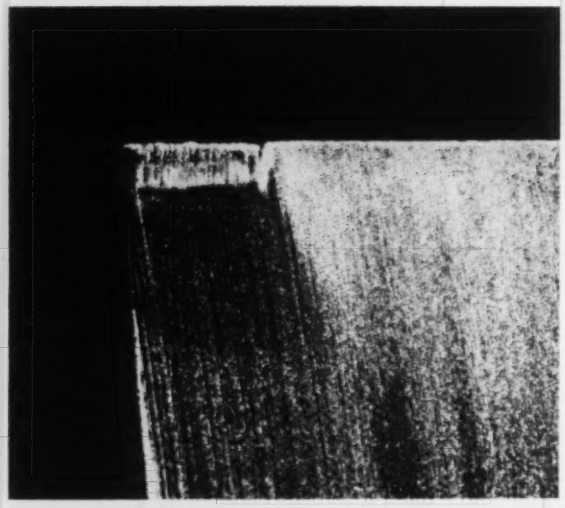
Sufficient data for high-speed-steel tools have not been obtained to allow determination of the tool-life speed relationship, but cutting speeds above about 100 sfpm appear to give limited tool life. Ceramic tool life has not been measured but should be extremely good.

Representative tool-life data for the machining of beryllium (0.015-in. wear land) as compared to other materials [4, 5] are shown in Fig. 11. The life of tools when machining beryllium is seen to be comparable to that for steel and far better than that for titanium and its alloys.

Conclusions

Beryllium chip formation is predominantly a brittle-fracture process irrespective of the cutting speed, feed, or tool geometry used; however, some plastic flow of the chip is observed. Chip uniformity and surface finish improve with light feeds and high tool rake angles. Surface cracking, stick-slip friction, and built-up-edge formation on cutting tools are phenomena associated with beryllium cutting.

Comparison of a slow, safe machining procedure with a severe roughing operation followed by two finishing cuts revealed no significant differences in the number or severity of surface cracks left on the machined



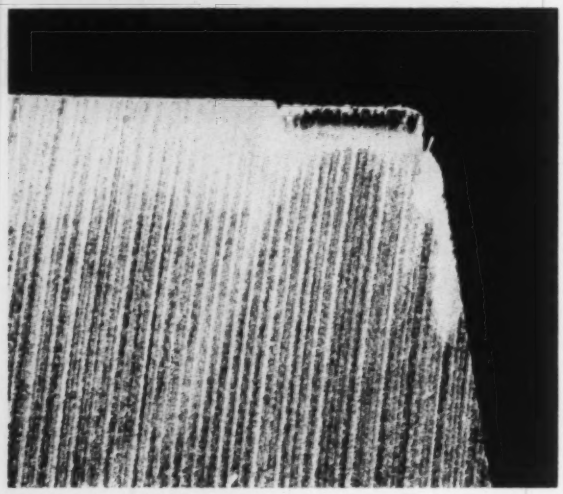


Fig. 9 Wear of Carboloy 44A tool after cutting beryllium (×18). (*a*) Clearance or flank face. (*b*) Rake or cutting face.

BERYLLIUM MACHINING CHARACTERISTICS

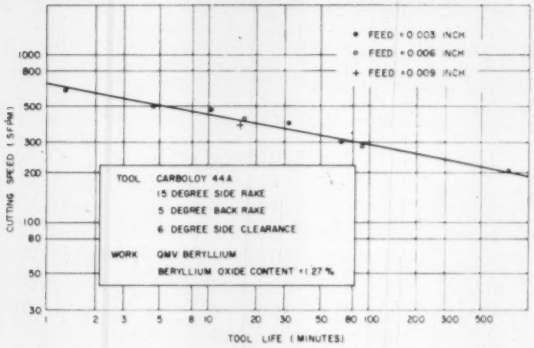


Fig. 10 Cutting speed versus tool life for beryllium machining

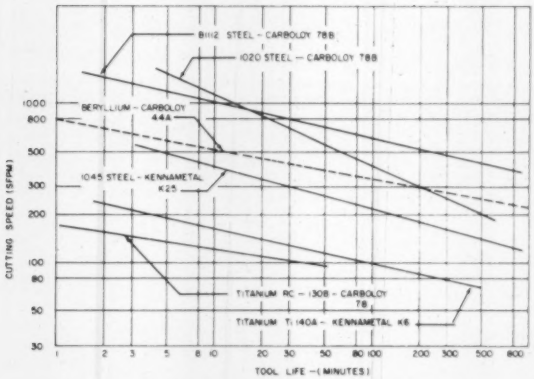


Fig. 11 Cutting speed versus tool life for various tool-work combinations (additional data from references [1] and [2])

surfaces. The final pass in both machining sequences was of 0.002-in. depth. Surface cracks were found to be removable by a 0.002-in. chemical polish in both cases.

The beryllium-oxide content of machining scrap is only 0.1 to 0.2 per cent higher than that of the parent metal and is not an important function of either cutting speed or tool geometry.

Temperatures produced at tool-chip interfaces in beryllium machining increase rapidly with increasing cutting speed and increase to a lesser extent with increasing feed. Chip-tool friction is quite low at normal cutting speeds.

The life of tungsten-carbide tools in beryllium machining is comparable to that found in machining low and medium-carbon steels and much greater than that in machining titanium alloys. Tool life varies with cutting speed according to the same empirical relation applicable to most metals. Tungsten-carbide tools give much greater tool life than high-speed-steel tools. Ceramic tools can be used to machine beryllium with good results.

Acknowledgments

Mr. J. Osebold assisted in the motion-picture machining study. Dr. J. Hull and Messrs. G. Theophanis, G. Hanson, and J. Lupo constructed and operated the spark source used to photograph beryllium machining. Electron-microscope work was performed by Ladd Research Industries, Roslyn Heights, N. Y. Mr. J. Phaneuf performed the chemical analysis of chips for beryllium-oxide content. Photomicrographs were made by Messrs. J. Richards and A. Dano.

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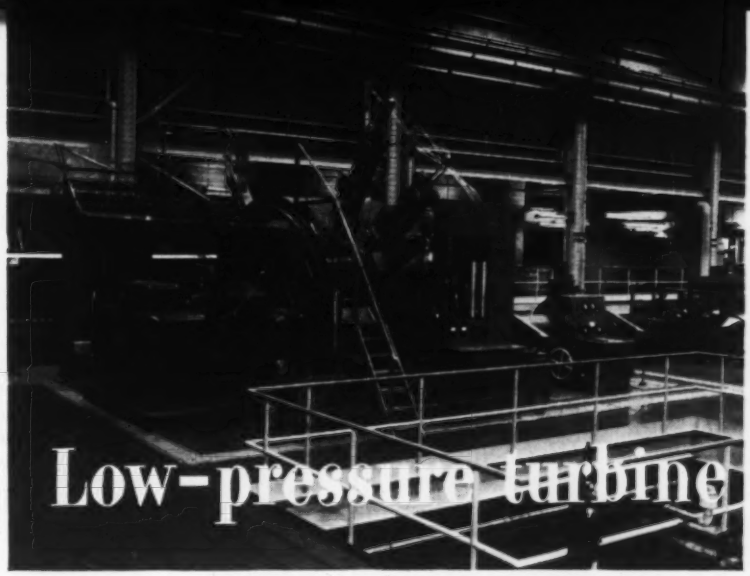

Fig. 1 Low-pressure turbine

Low-pressure turbine testing

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Schenectady, N. Y.

Improvements in l-p turbines have already resulted from this new facility which allows accurate measurement of efficiency

In the past, measured efficiency of low-pressure sections of large steam turbines has been available only from field tests on complete units. Although not directly measured, the efficiency of the last several stages could be derived by subtracting from the over-all results the directly measured performance of the other sections of the unit. Unfortunately, this procedure causes all test errors to accumulate in the l-p section and the resulting accuracy is less than that required to effectively evaluate design improvements.

In an h-p development test turbine, full-scale steam parts can effectively be tested at pressure, flow, and output levels a fraction of normal design values, but an l-p test turbine has some special restrictions which do not permit the use of these economies. Since it is not feasible to reduce exhaust pressure below that available from a condenser, this pressure is established at the same level as obtained in normal steam-turbine operation. Thus normal initial pressure is required to produce correct values of pressure ratio, Mach numbers, and ratios of steam velocity to bucket speed. The use of full-scale parts, to provide correct Reynolds numbers in the critical low-Reynolds-number range in which these stages operate, results in large and expensive requirements for steam flow, condensing, and load-absorbing capacities.

In 1953 the authors' company started construction of a full-scale l-p testing facility to be housed in a new turbine-product development laboratory. The test of the first group of stages was started in 1955. An accurate measurement of efficiency was obtained at various speeds, initial conditions, and exhaust pressures. Traverse data were taken in the discharge stream of the last and next-to-last stages, and interstage pressures measured. Modification of this l-p turbine on the basis of these measurements improved the level of efficiency 3 per cent.

[1] Manager, Turbine Advance Engineering.
[2] Supervisor, Turbine Performance Engineering.

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Description of Facility

The steam supply of 300,000 lb per hr to this facility is from a 400-psi, 700-F source. Desuperheating equipment provides control of initial temperature to the turbine throughout the operating range of 400 F superheat to 5 per cent moisture at full load. The output is absorbed by two tandem, 15,000-kw water brakes with a design-speed range from 1800 to 4000 rpm. The steam exhausts downward to a 37,500-sq ft condenser which at full load and 39 F circulating-water temperature provides an exhaust pressure as low as $^3/_4$ in. Hg abs, and is controlled by bleeding air into the condenser. Thus tests can be run over a range of initial pressure and steam flow, initial superheat, exhaust pressure, and rpm to determine the effect of these variables on performance and operating characteristics.

The general arrangement of the test turbine and instrumentation is shown in Fig. 1. A cross section of the casing and the first set of steam parts tested is shown in Fig. 2, with location of instrumentation noted. The permanent parts are the stub shafts on either end of the rotor body, the inlet casing, and the exhaust hood. The inner casing, diaphragms, and the central rotor body are different for each set of steam parts tested. The exhaust hood is somewhat larger than required for our present largest 3600-rpm last-stage bucket to allow for future growth. Comparatively light, internal lagging is used to duplicate the exhaust-flow passage when testing smaller steam parts.

Turning vanes and screens in the inlet provide uniform flow to the first stage. This configuration was developed by testing a scale model in the air-test laboratory. The final design provided a variation in total head in the inlet annulus less than ±0.05 per cent of the available energy across the turbine stages.

The two 15,000-kw water brakes which absorb the power generated are cradled for measuring torque, which is applied by electrically placing calibrated weight (up to 8600 lb) on rods connected to the end of each torque arm and extending below the floor. Test points

are run at constant torque by first placing the required amount of weight on the weight rods. The positions of the torque arms are then maintained automatically within ±0.020 in. through pneumatic systems which operate bypass valves on the water inlets to the brakes. This method of control has been very successful. These water brakes are far beyond any previous experience with respect to power absorbed and rpm, but the internal parts have been subject to very rapid water erosion. Some improvement was obtained by depositing hard facing material in the areas of greatest wear, but it is still necessary to replace the impellers and stator plates frequently.

Initial steam pressure is held constant by a pressure regulator operating a bypass around the main throttle valve, Fig. 3. Five to 20 per cent of the total steam flows through the bypass and a special pressure regulator was developed to provide fine control of this valve which, with the water brakes operative at constant torque, holds turbine speed constant within 10 rpm. The system is designed with adjustable range of 15 to 385 psia.

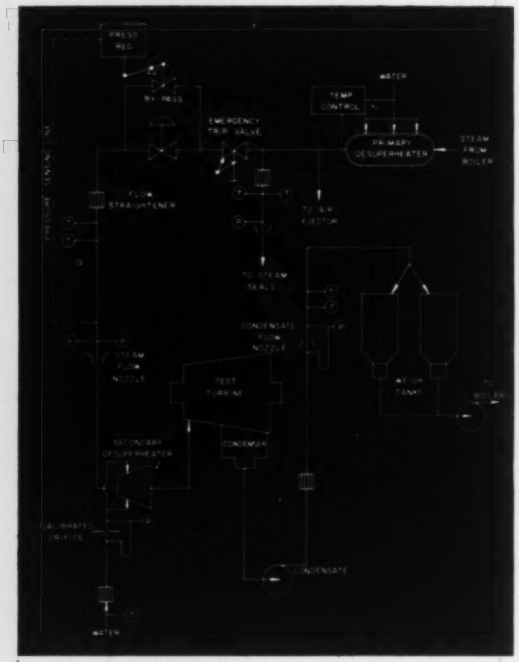
Temperature is automatically controlled by the primary stage of desuperheating within ±1 F, with an allowable straight-line drift of 0.1 F per min. The secondary stage of desuperheating is set manually. The thermocouple sensing element is connected to a pneumatic controller which in turn operates a diaphragm valve on the primary desuperheating water-spray nozzle.

Instrumentation

Flow. The steam flow to the turbine is measured with a critical-drop steam-flow nozzle. After passing through the turbine, this flow is condensed, measured with a water flow nozzle, and then weighed, thus giving three independent accurate methods of measuring flow. The weigh tanks and scales are part of a nozzle-calibration facility designed to permit high accuracy calibration at high Reynolds numbers. For instance, a 5-in. nozzle in a 12-in. pipe can be calibrated at Reynolds numbers up to 5 million with an accuracy of ±0.1 per cent.

Precision dead-weight gages are connected to scale heads for measuring the pressure at two taps ahead of the critical-drop steam-flow nozzle, Fig. 4. The pressure can be varied from 15 to 385 psig, with 0 to 75 psi measured on the scale heads (least scale division 0.05 psi) and the remainder measured by 50-psi weights added to the dead-weight gages.

Load. The output is determined by measuring the water-brake torque as described, and by measuring rpm using an electronic tachometer which is accurate to within ±0.05 per cent. A check, obtained by measuring water and oil flow and their temperature rise through the water brakes, is quite convenient in locating testing errors and gives assurance of the accuracy of the load measurement.



◀ Fig. 3 Schematic arrangement of steam & condensate lines

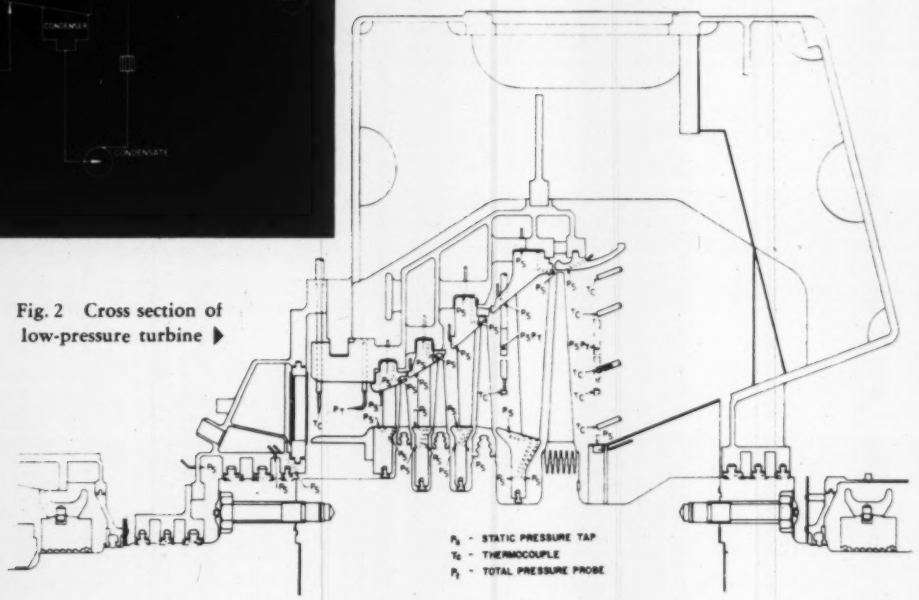


Fig. 2 Cross section of low-pressure turbine ▶

Traversing mechanism and probes. Once the over-all performance of a turbine configuration has been determined, the question of what can be done to improve it always arises. This can sometimes be answered by more detailed measurements throughout the steam path, Fig. 2. Among the most important measurements are the traverse data providing impact and static pressures, impact temperatures, and radial and circumferential-flow-angle variations across the steam path.

The four traversing mechanisms on the right side of the turbine are shown in Fig. 5. Two of these are for positioning the temperature probes in the discharge stream of the last and next-to-last stages. The other two are for positioning the pressure and angle probes. Four similar traversing probes are located on the left side of the turbine.

U-tubes are used in setting the pressure probe at the proper angles, manometers measure static and total pressure, and *X-Y* recorders plot temperature versus radial distance.

A special traversing probe, Fig. 6, was designed for measuring radial and tangential angles, total pressure, and static pressure of the steam leaving the last and next-to-the-last-stage buckets. The major components of this probe consist of a spherical end with two pressure tap holes at the side, located 50 deg from the zero-angle impact point, and two vertical-pressure tap holes located 60 deg apart on the rotatable center portion of the sphere. The side pair of taps is pressure-balanced by rotating the whole probe about its axis to align the probe with the flow and thus determine tangential leaving angle. The vertical pair is then pressure-balanced by rotating the center portion of the sphere thus measuring radial angles. The actual stream radial angle is obtained from calibration curves. Total pressure is then obtained by again rotating the center portion until one of the two taps is lined up with the flow. Pressure tap number 3 is used in conjunction with calibration curves to obtain the value of static pressure.

Temperature traverses are made with a high-recovery thermocouple probe that will measure impact temperature within 2 per cent of the velocity head when misaligned with the flow as much as 60 deg. This flow angle insensitivity is obtained by the use of a Kiel ring directing the flow into a $^{3}/_{16}$-in-diam spade-type shield in which a bare thermocouple is mounted. The Kiel ring also acts as a radiation shield for the thermocouple. An attempt was made to use this probe during a moving traverse, but temperature gradients across the annulus proved to be too great. It was necessary to position the probe in steps and wait for the themocouple to indicate a steady temperature.

Results

The following tabulation gives values of repeatability and absolute accuracy for the individual measurements:

Measurement	Per cent repeatability	Per cent absolute accuracy
Initial pressure	0.01	0.01
Initial temperature	0.05	0.10
Exhaust pressure	0.06	0.08
Throttle flow	0.02	0.30
Speed	0.03	0.05
Load	0.10	0.04
Root-mean-square value	0.10	0.35

The standard deviation of the difference between flow measured by the critical-drop steam nozzle and by weighing the condensate flow is 0.2 per cent.

Data from the pressure and temperature traverses are reviewed for consistency. An IBM 704 Electronic Data-Processing Machine calculates leaving velocity, axial velocity, integrated flow, and integrated average leaving

Fig. 4 Indicating dead-weight gages

Fig. 5 Traverse mechanism

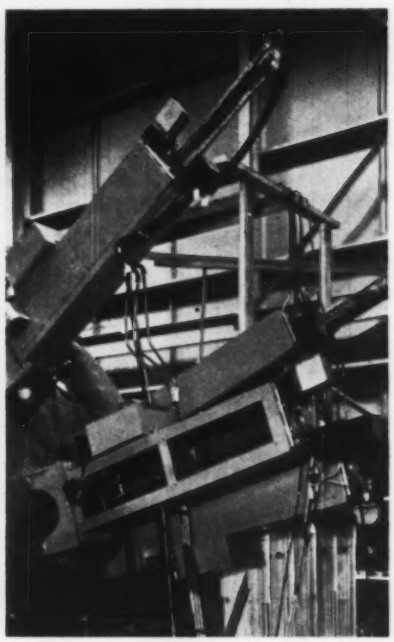
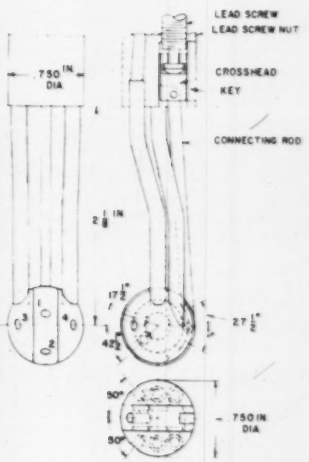


Fig. 6 Four-hole radial-angle probe



loss, pressures, and temperatures. A typical plot of third-stage traverse data is shown in Fig. 7. Integrated flow from traverses at the third stage usually agrees with measured flow within about 5 per cent. Calculations such as energy in the leaving stream are obtained from these traverse data corrected for flow. The integrated-flow and radial angles are used to construct stream lines which are useful for the analysis of nozzle and bucket performance at selected radial locations.

By operating the turbine with initial superheat considerably higher than design, the flow leaving the last stage is superheated and temperature traverses can be made both before and after the last stage. From these data are obtained curves of efficiency versus radial height for the first three stages and the last stage, which pinpoint loss regions and indicate design changes for improved performance.

Since such valuable information is obtained at off-design conditions, it is necessary to determine the effects of superheat and velocity ratio on efficiency, Figs. 8 and 9.

Special measurements are made on this development turbine to establish testing procedures on steam turbines in commercial operation. For example, six basket tips and six wall-pressure taps are installed at the turbine-exhaust flange for measuring exhaust pressure. A typical pressure-contour map is shown in Fig. 10. An integration of this contour map gives an average flange static pressure. An analysis of these data at different exhaust pressures shows that an accurate exhaust-pressure measurement can be obtained on steam turbines in commercial operation by placing two basket tips per end at the locations indicated by X in Fig. 10. The basket tips should be installed at an angle of 45 deg to the direction of the flow in a plane about 6 in. above the exhaust flange. Also, 12 thermocouples located at the exhaust flange, Fig. 11, were installed for the purpose of measuring l-p turbine enthalpy-drop efficiency when the turbine is operated with superheated exhaust. The agreement between load and enthalpy-drop efficiencies, based on a numerical average of the flange thermocouples, appears to be a function of exhaust pressure. At 1½ in. Hg the difference is about 2 per cent; at 2 in. Hg (Fig. 11) it is about 1 per cent; and at 4 in. Hg the enthalpy-drop efficiency agreed with the load efficiency. Considerable work is required before this method could be used to test turbines in commercial operation. However, the results thus far are encouraging. On units with double reheat at an exhaust pressure of 2 in. Hg and half load, the exhaust is superheated by 25 F which is sufficient to give accurate temperature measurements. The performance of both the h-p and i-p sections of turbines in commercial operation can be accurately measured by the enthalpy-drop method. If the same method could be used to measure the performance of the l-p section, the time and expense of testing turbines would be considerably reduced.

Conclusions

Test results obtained from this facility during the past two years have led to significant improvements in l-p turbine efficiency. We expect future tests and further analysis of the test data obtained thus far to give us a better understanding of the complex behavior of flow through these stages which will enable us to design more efficient stages in the future.

By J. P. Denny[1] and L.

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[1] Physical Metallurgy Specia
[2] Nuclear Materials Enginee

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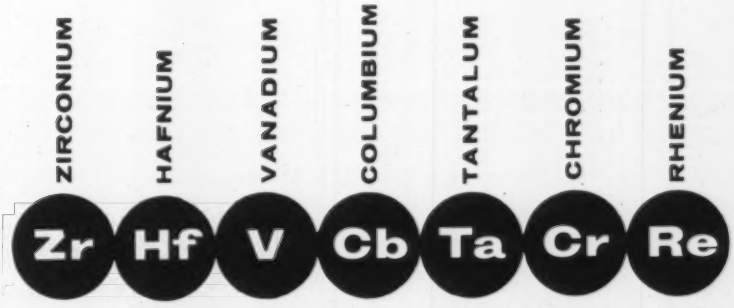

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ENGINEERING METALS

Designers are broadening their materials-engineering base. They need metals that combine high strength with resistance to heat and corrosion. Here are the new fledgling metals.

h the need for materials of unprece-
t resistance, and corrosion resist-
y are employing metals formerly
mpractical.

re: zirconium and hafnium (periodic
anadium, columbium, and tantalum
ium (group VI B); and rhenium
are available in at least develop-
Considerable data are available on
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2).

ZIRCONIUM

e of age. The capacity for produc-
n the United States has increased
n a few thousand pounds in 1947 to
n 1958. The impetus for this rapid
marily from this country's atomic-
ch will consume 3,200,000 lb per
availability of zirconium in quan-
gners to exploit its unusual proper-
plications.

e zirconium" is actually an alloy
een 1.0 to 2.5 per cent hafnium, de-
osition of the ore. It is perfectly
every application, but the nuclear
necessitate its removal if the zir-
n atomic reactors. The separation
chemical processing to yield "re-
n" containing less than 0.01 per

tions, minor amounts of tin, iron,
are usually added to pure zirco-
e alloys, zircaloy-2 and 3. These
corrosion resistance in very high-
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hine Design Division and presented at the
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MD-4, "Uncommon Engineering Metals."

such as—plate, sheet, rod, wire, tube, and castings.

The practical price. The price of zirconium recently has been substantially reduced, reflecting the competitive nature of this young business. In 1000-lb lots, commercial-grade sponge is now priced at $5 per lb, while reactor-grade sponge is quoted at $7.50 per lb. These prices are only one third those of four years ago.

The outstanding property of zirconium is its corrosion resistance. Media in which it is especially useful include hydrochloric, nitric, sulfuric, and phosphoric acids, hydrogen peroxide, most chlorides, and most organic acids. In this respect, it is comparable to titanium, tantalum, Stellite, the Hastelloys, and the stainless steels. For some applications, zirconium is markedly better than any of these since it is resistant to both alkaline and acidic media.

Zirconium has a lower density than stainless steel while its thermal conductivity is about the same. Although zirconium is moderately strong at room temperature, the strength drops rather sharply at elevated temperatures. Alloying counteracts this tendency to a considerable extent. At temperatures above about 900 F, zirconium and the alloys must be protected from prolonged exposure to CO, CO_2, SO_2, steam, hydrogen, and flue gases. Because of the deleterious effects of nitrogen and oxygen, these metals should not be used in air above 1200 F.

Zirconium and its alloys can be fabricated and processed by the standard techniques used for stainless steels and titanium. Hot-working operations must be performed in protective sheaths or atmospheres except for very heavy sections such as ingots and thick plate. In addition to forging, rolling, swaging, drawing, and forming, extrusion is useful for producing pipe, tubing, and complex shapes.

Zirconium is also readily formed by powder-metallurgy techniques. It can be joined by welding under an inert shield or silver brazing in vacuum. Special techniques have been developed for joints to dissimilar metals. With sharp, carbide-tipped tools, zirconium is easily machined when the machinist has been instructed properly. Since fine zirconium chips burn vigorously if ignited, accumulation of these around machines should be minimized.

Zr Hf V Cb Ta Cr Re

Industrial applications. Zirconium's use in boiling-water and pressurized-water reactors seems assured for the foreseeable future, since its nuclear properties and corrosion resistance make it nearly ideal for these applications; furthermore, the recently reduced prices increase the margin of advantage of zirconium over other candidate metals. Lower prices will certainly result in extensive use of zirconium for new chemical-processing equipment and related applications where corrosion problems are severe.

Among the devices which have been fabricated of zirconium are: heat exchangers, valves, reaction vessels, agitators, fan blades, and steam ejectors for use with hydrochloric acid. Other applications include alloys, especially with magnesium and as a deoxidant in steels; getters to remove traces of gaseous contaminants from electron tubes; seals of glass and ceramics to metal; and pyrophorics such as flash bulbs, fireworks, and primers for explosives. Potential uses include electrolytic capacitors and rectifiers in place of presently used tantalum, surgical devices for use in the human body, and for hard, corrosion-resistant fountain-pen tips.

HAFNIUM

Hafnium has become available in practical quantities as a result of the atomic-energy program to produce zirconium. The two metals are very similar in nearly all of their properties.

Hafnium occurs in ores with zirconium; in fact, no occurrences are known of one without the other. The hafnium is presently separated as a by-product in the chemical processing of reactor-grade zirconium. Conversion to the metal is accomplished by thermal decomposition of the tetraiodide to form crystal-bar hafnium or by reduction of the tetrachloride with magnesium or sodium. The present price is about $70 per lb.

It absorbs neutrons. In general, hafnium has the properties of zirconium; the most important exception to this is the absorption of thermal neutrons. Pure zirconium absorbs very few neutrons so that it is useful for structural components in reactors, whereas hafnium has an unusually high absorption and is useful for controlling reactors by absorbing excess neutrons. Hafnium also has a higher melting point than zirconium, a much higher allotropic transition temperature, and nearly twice the density. Like zirconium, hafnium is unusually resistant to many corrosive fluids but is attacked by air and other gases at elevated temperatures.

When uncontaminated by nitrogen or oxygen, hafnium can be fabricated with nearly the same techniques used for zirconium. It has been forged, rolled, extruded, drawn, machined, and welded successfully.

In addition to its application to control of nuclear reactors, hafnium should be useful in applications where the corrosion resistance of zirconium and high transformation temperature are required.

VANADIUM

Ores of vanadium are both domestic and foreign, with principal United States deposits being in the western part of the country, notably in Colorado and Utah. The commercially purified metal is available in the form of buttons or lumps, and small quantities are being supplied in wrought form for experimental purposes.

Vanadium in button form is sold for approximately $65 per lb, and may be obtained in the form of lumps for $50 per lb. While such prices are relatively high in comparison with many commercial metals, the cost represents a significant reduction from quotations obtained as recently as 1950 of $1800 per lb.

Possible structural applications. In the hot-rolled and annealed condition, vanadium has a pronounced yield point, and its stress-strain curve accordingly resembles that of mild steel. Its density is 0.22 pci and its modulus of elasticity is $18\text{–}19 \times 10^6$ psi. This interesting combination of properties suggests possible future structural applications.

A body-centered cubic material, vanadium undergoes a transition from ductile to brittle fracture at temperatures of -76 to -338 F, dependent upon oxygen, nitrogen, and carbon content. Low levels of oxygen, nitrogen, and carbon are associated with optimum fracture characteristics.

From the corrosion standpoint, vanadium is resistant to alkaline and hydrochloric-acid solutions, but is not resistant to oxidizing acids such as nitric. Its resistance to salt water and salt spray may be classed as fair to good. There is evidence that it resists pitting by salt water but is subject to general corrosive attack.

The electrical resistivity at room temperature is 24.8 microhm-cm, higher than most of the common metals. It is a poor conductor of magnetic flux.

Vanadium does not work-harden rapidly and may be cold-worked readily. It is a free cutting material and good machining results have been reported with tool characteristics similar to copper. Remelting and welding operations require protective atmospheres to prevent reaction of the metal with oxygen and nitrogen above 550–600 F. For welds requiring optimum purity, an argon atmosphere is recommended. The material can be hot-worked, and one technique employs an austenitic stainless-steel sheath to protect it from the atmosphere. Fabrication procedures for such composites are similar to those used in the stainless-steel industry.

Vanadium is used as an alloying element in steels. High-purity vanadium has been rather extensively investigated by the Atomic Energy Commission, but its value in such applications is uncertain. The metal is currently used as a target in x-ray tubes, and its broader utility as an engineering material presents interesting possibilities. The relatively high electrical resistivity, combined with an intermediate density and modulus of elasticity, merits consideration.

COLUMBIUM

The availability of columbium (niobium) has changed from acute shortage to abundant supply. Ten million pounds of concentrates were produced during 1954, and the United States imported over 80 per cent of this total. Nigeria has been the most important source of columbium ores. Canadian deposits of substantial extent have been discovered, and steps are being taken to insure domestic availability. A principal domestic supplier is expanding facilities to increase production 150 per cent.

The bulk of columbium powder is produced to a specification calling for a minimum of 99.5 per cent columbium, with stringent requirements on the quantities of many minor elements.

NEW ENGINEERING METALS

Table 1 Physical Properties of Unusual Metals

	Zr ZIRCONIUM	Hf HAFNIUM	V VANADIUM	Cb COLUMBIUM	Ta TANTALUM	Cr CHROMIUM	Re RHENIUM
Atomic number	40	72	23	41	73	24	75
Atomic weight	91.22	178.6	50.95	92.91	180.88	52.01	186.31
Density, pci	0.235	0.472	0.22	0.31	0.60	0.26	1.06
Melting point, deg F	3360	3600-4000	3150	4380	5425	3430	5756
Crystal structure (RT)	HCP	HCP	BCC	BCC	BCC	BCC	HCP
Allotropic transition, deg F	1584-BCC	3540-BCC	None	None	None	HCP[c]	None
Linear coeff. of expansion (microin./in.deg F at 68 F)	3.0	3.4	4.3	4.0	3.6	3.4	3.6
Thermal conductivity Btu sq ft/hr/in./deg F	118 (68 F)	- -	215 (212 F)	365 (32 F)	377 (68 F)	464 (68 F)	495 (68 F)
Specific heat, Btu/lb deg F	0.067	0.035	0.120	.065	0.36	0.11	0.033
Electrical resistivity, microhm-cm at RT	40-45	32	26.	13.2	12.4	13	19.5
Modulus of elasticity, tension, psi x 10^6	13	20	18.5	10.4[a]	27	36	67.
Recrystallization temp. deg F 1 hr[b]	930-1020	1300-1400	1580	1920	2550	1470	2550

[a] Subject to confirmation. Values in the literature vary from 12.4 x 10^6 to 30.4 x 10^6.

[b] Varies according to degree of cold work.

[c] Below 79 F

Table 2 Mechanical Properties of Unusual Metals

Metal and test temp	Tensile strength, 1000 psi	Yield strength (0.2% offset), 1000 psi	Elongation, per cent
ZIRCONIUM			
Pure, annealed, RT	34	10	47
Commercial, annealed, RT	50	35	35
Commercial, 40% CW, RT	80	70	15
Zircaloy 2			
Annealed, RT	68	45	22
Annealed, 500 F	52	18	36
Hot-rolled, RT	88	66	42
40% CW, RT	108	99	36
HAFNIUM			
Pure, annealed, RT	59	22	35
Pure, annealed, 500 F	38	12	51
Pure, hot-rolled, RT	79	63	15
VANADIUM			
Commercial, annealed	70	63	32
Commercial, hot-rolled, RT	91		22
Commercial, hot-rolled, 1112 F	40		58
Commercial, hot-rolled, 1832 F	7		50
COLUMBIUM			
Commercial, RT	39	24[a]	49
Commercial, 1022 F	32	10.5[a]	24
TANTALUM			
Commercial			
Sheet, annealed, RT	50		40
Sheet, worked, RT	110		1
Wire, annealed, RT	100		11
Wire, worked, RT	180		1.5
CHROMIUM			
Pure, annealed, 626 F	41	27	14
Pure, annealed, 1965 F	9	9	104
RHENIUM			
Pure, annealed, RT	164	135	28
Pure, worked, RT	322	311	2
Pure worked, 1850 F	124		1
Pure worked, 2700 F	49		1

[a] Proportional limit.

To obtain further purification, the powder may be processed such that its carbon content is slightly greater than 0.1 per cent. Upon subsequent arc melting, the excess carbon reacts with oxygen and facilitates oxygen removal. In massive form, a higher purity 99.8 per cent minimum columbium can be produced by high-temperature sintering; this product can be fabricated or used as consumable electrodes in arc melting.

Columbium powders and granules are now being supplied by several manufacturers, and wrought forms are available on special order. Sheet, strip, foil, wire, rods, and other shapes can be produced by powder metallurgy or arc-melting followed by cold-working. Tubes may be made by forming and welding of strip. Pressed and sintered arc-melting electrodes are also available. Powder costs, dependent on quantity and purity, vary from $43 to $76 per lb. The cost of fabricated products such as sheet and strip is approximately $90 per lb.

For nuclear applications. The low thermal neutron capture cross section of columbium (1.2 barns) makes it attractive for nuclear applications, and it is being used as the canning material for fuels in experimental reactors. It does not work-harden rapidly and can be cold-rolled and formed readily. It is resistant to acid corrosion, although it is inferior to tantalum in this respect. The material has strength at 2200 F comparable to that of pure molybdenum, and has an attractive density (0.31 pci) in comparison to other refractory metals. Columbium is embrittled by nitrogen, and this phenomenon has hampered its ready acceptance as a high-temperature structural material. It is a superconductor at temperatures below 8 K, having the highest superconducting temperature of any known element with the exception of technicium (11.2 K).

Most of the procedures for working and fabricating columbium are conventional. It has a tendency to gall during machining. Forming, bending, stamping, and deep-drawing operations are done at room temperatures so as to avoid embrittlement resulting from reaction with gases at elevated temperatures. It can be softened by vacuum annealing, with high vacuums required to avoid gas contamination. Columbium can be welded to itself by resistance welding and inert-arc welding. A properly made weld is ductile. It may be chemically cleaned with hot chromic acid.

An alloying agent. Currently, there are no commercial applications for columbium except as an alloying agent. Considerable experimental work is being directed toward the development of columbium-base alloys for elevated-temperature structural applications as well as nuclear applications. Possibilities also exist for its use in electrolytic capacitors and in Cryotrons for computer application.

TANTALUM

Tantalum ores are associated with columbium deposits, and the majority of concentrates come from Africa. There are also small producing deposits in Brazil and western Australia. Tantalum is potentially in shorter supply than columbium. A five-fold increase in tantalum consumption, presently estimated at 50 tons per year in the United States, appears to be about all the present deposits would supply. This would require the use of lower grade concentrates with increased production costs.

Tantalum is converted into massive form by sintering in vacuum. The powder is pressed into bars, and resistance heating under vacuum consolidates the metal to a density which is 90 per cent of theoretical. Subsequent working by forging or rolling essentially eliminates porosity and the product approaches 100 per cent theoretical density.

Commercial forms. Tantalum is available in various forms such as rod, sheet, wire, and foil. Tubing may be produced by welding on special order. The cost of tantalum powder varies from $46–$60 per lb according to desired purity and size of order. Fabricated forms are available at approximately $70 per lb.

Tantalum has exceptional resistance to corrosion by acids such as hydrochloric, nitric, sulfuric, and phosphoric. It forms anodic oxide films which are of exceptional stability below 300 C (572 F). It oxidizes readily above this temperature, however, and alloy development or protective coatings will be required for elevated-temperature service in air. It has a low vapor pressure at 2225 C, being superior to other refractory metals in this respect with two exceptions (rhenium and tungsten). Tantalum may be welded to itself and certain other metals by resistance welding. Seam-welding is usually done under water to prevent oxidation of the metal. Light welding pressures should be used, since heavy pressures lead to so little resistance across the joint that no weld is made. Tantalum also can be joined by inert-arc welding.

The metal can be annealed by heating in vacuum to above 1275 C (2327 F), its recrystallization temperature. Cold-forming is preferred because of its oxidation characteristics. In lathe operation, high cutting speeds using high-speed tools are preferred. Slow speeds will cause the metal to tear. Carbon tetrachloride is recommended as a cutting medium, and the work must be kept flooded at all times. The metal also can be milled, drilled, threaded, and tapped. Grinding is difficult.

Corrosion resistance. The most important uses for tantalum are based on its corrosion resistance. It is used in the chemical industries for the processing of such materials as chlorine, hydrochloric acid, chlorides, and nitric acid. Applications include heat exchangers, condensers, coils, and bayonet heaters. Immune to body chemicals, it has been used for implants in humans.

Tantalum is used in electronic tubes, where its high melting point, low vapor pressure, gettering properties, and copius electron emission at reduced power levels are advantageous. Tantalum electrodes are used in electrolytic rectifiers, and tantalum sheet is being employed in capacitors. The oxide film which acts as the dielectric is formed on tantalum by anodic oxidation prior to assembly. The future should see continued usage of tantalum in these and related applications utilizing its exceptional corrosion resistance, the good dielectric characteristics of its oxide, and other unusual properties.

CHROMIUM

The emergence of chromium and chromium-base alloys for structural and other applications is recent.

Major deposits of chromite, its principal ore, are located in Russia, the Union of South Africa, Southern Rhodesia, Turkey, and Cuba. Nearly all of the chrome ore used annually in the United States is imported. However, numerous small and low-grade deposits are known

in the United States which can be worked under conditions of national emergency.

A number of vendors supply chromium powder. Wrought forms may be obtained in experimental quantities.

The cost of chromium powder is $1.50 to $5.50 per lb dependent on purity and quantity.

Table 1 shows that chromium undergoes an allotropic change at 79 F. In addition, a second allotropic transformation probably occurs at a temperature approximately 100 deg C below its melting point, consisting of a transition from the normal body-centered crystal structure to face-centered cubic.

Brittle and reactive. The primary deterrent to commercial structural application of chromium has been its room-temperature brittleness caused by nitrogen impurities. Carbon is also thought to have deleterious effects. The oxidation resistance of chromium is good at elevated temperatures but inferior to nickel-chromium alloys.

Because of its reactive nature, chromium must be melted in vacuum or in an inert atmosphere. The molten metal is usually superheated to obtain sufficient fluidity, and casting temperatures are approximately 2000 C (3632 F). Prior treatment of the furnace charge at elevated temperatures in pure dry hydrogen removes sufficient gaseous impurities to facilitate the casting process. Resultant ingots are hot-worked by extrusion, forging, and swaging. Sheaths are sometimes used to prevent contamination. Powder-metallurgy processes also may be used for consolidation.

Development priority has been given to the production and properties of chromium, and only limited work has been done in the joining, forming, and machining areas. It recently has been established, however, that brittle cold-worked chromium can often be made ductile by etching away the surface. This may be performed anodically in an orthophosphoric-acid sulfuric-acid bath or by direct immersion in hydrochloric-acid solution. The effect is attributed to the removal of heavily nitrided surface layers formed during fabrication.

The potentialities of chromium and chromium-base alloys for structural application are not regarded as good at the present time. Work is continuing in the area, however, and a technical break-through is definitely within the realm of possibility. It is considered likely that the initial application of chromium-base alloys will be in other areas such as bearings, tool materials, and die materials, wherein high hardnesses developed by surface reactions with nitrogen can be employed advantageously.

Re RHENIUM

Only during the past three or four years has the technology been acquired which now promises to make rhenium a commercial product.

The principal source of rhenium is the flue dust obtained on roasting a copper ore found in Arizona. If desired, rhenium powder of 99.95 per cent purity can be obtained.

The best method for consolidating the powder is by pressing and sintering, although arc-melting is useful in certain applications. Crystal-bar rhenium can be obtained by thermal decomposition of the pentachloride; this method can also be used successfully to plate base metals if careful control is maintained.

A difficult metal. Rhenium is difficult to fabricate, but recent work has demonstrated that special techniques can produce bars, strip, foil, and wire from the sintered powder. Arc-melted and crystal-bar rhenium, however, can be worked only slightly before failure. Because of hot shortness, rhenium cannot be hot-worked and, instead, must be cold-worked with frequent anneals at about 3100 F since cold-working to 30 per cent area reduction triples the hardness of the metal. Despite these difficulties, 0.003-in. foil and wire have been fabricated. At present, rhenium powder is quoted at about $2000 per lb; no doubt the price reflects a lack of demand and will be reduced as production is increased.

The outstanding property of rhenium is its combination of high melting point, low vapor pressure, ductility at room temperature, and very high strength.

Among the unusual physical properties of rhenium are its density, the fourth highest among the elements; its melting point which is second only to graphite and tungsten; and its vapor pressure which is much lower than that of either tantalum or tungsten. Although it oxidizes catastrophically on heating in air, it is very stable in hydrogen or vacuum.

Rhenium, unlike tungsten, is not attacked by the "water cycle" which produces failure of tungsten filaments in vacuum tubes by continuously depositing tungsten on the cool tube walls. Rhenium has been shown to be resistant to molten tin, zinc, copper, and silver, although it fails in aluminum, nickel, and iron. It is also unattacked by aluminum oxide during 7000 hr at 2900 F.

Many of the mechanical properties of rhenium are notable. Its modulus of elasticity is exceeded only by osmium and iridium; its tensile strength at room temperature is higher than that of tungsten; it is appreciably ductile at room temperature in contrast to tungsten. At elevated temperatures, the ductility of rhenium is poor, although in tensile and creep-rupture properties it is superior to tentalum, columbium, and tungsten up to at least 2500 F.

A wide potential. The potential applications of rhenium include electron tubes, and contacts in electrical relays and switches. The use of rhenium in electron tubes is attractive because of its inertness to the water cycle, its strength, and its refractory nature. The applicability of the metal and several binary alloys with tungsten and molybdenum is currently being investigated.

Rhenium as a contact metal has already been put to limited use in magnetos for marine engines. In this case, its resistance to corrosion in salt water combined with its resistance to electrical erosion, and its high strength and ductility make rhenium especially attractive. Its use is indicated for other applications requiring these properties such as pen points. For measurement of very high temperatures, thermocouples of rhenium with tungsten or molybdenum are usable to about 4500 F.

Acknowledgments

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Abstracts and Comments Based on Current Periodicals and Events

D. FREIDAY
Assistant Editor

BRIEFING THE RECORD

Fresh Water From the Sea

CONVERSION of sea water to fresh water has begun in a $10-million installation at Balashi on the Island of Aruba in the Netherlands West Indies. The world's largest single evaporation installation, it was designed and constructed for the island government by Singmaster & Breyer, New York, N. Y.

A unique combination of factors has made the Aruba installation possible. Fresh water is scarce on this semiarid island where much of the 16-in-a-yr rainfall (New York 42.94 in.) falls in November and December. Cheap heavy residual fuel is plentiful as the island is the site of one of the largest refineries in the world, built a quarter century ago by Lago Oil & Transport Company, Ltd., a wholly owned Standard Oil (N. J.) subsidiary.

Fresh water has been produced successfully in a smaller but obsolete and expensive plant for some time. The greatly increased quantities which the new plant will provide will permit another island shortage to be solved. Fresh fruits and vegetables do not ship well in the tropics, and the island's soil is limited and rocky. A 12-acre hydroponics farm will provide 4 acres of actual growing-trough space for ideal growing conditions in the 12-month season with water-dissolved chemicals. The American hydroponics expert in charge will have practical U. S. Army experience in Japan, years of laboratory experiments, and his own experience in managing a similar farm in Puerto Rico to draw on.

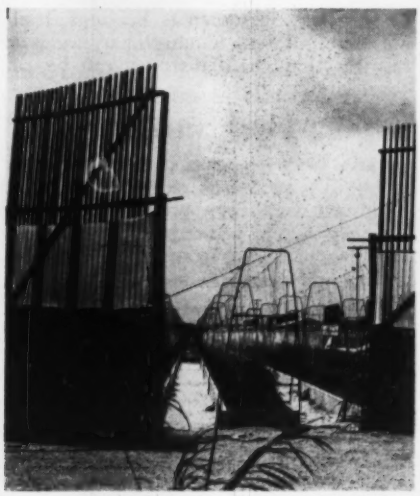
The solution to these problems is a salt-water-evaporating system run on the 20-psig exhaust steam from a 12,500-kw residual-fueled electric plant with a small quantity of 150-psig bleed steam used for the air ejectors of the evaporators. When the demand for electricity does not provide enough exhaust steam, the necessary quantity of higher pressure steam will be drawn and desuperheated. Condensing turbines can be added to the plant in the future if the island's electrical needs increase.

The Aruba plant produces fresh water from sea water by the submerged-coil multiple-effect distillation process. In this process sea water is heated and evaporated in one evaporator or "effect," then the latent heat released by condensation of this vapor is used to evaporate the brine in the next effect, and so on.

Five sets of Sextuple Effect Evaporators made by G. & J. Weir of Glasgow, Scotland, will reduce the 34,790-ppm sea water to potable fresh water with a maximum of 10 ppm. Each set consists of seven domed cast-iron shells—two are used for the fifth effect—about 11 ft in diam by 29 ft long with about 5000 sq ft of aluminum brass tubes in each effect, auxiliary preheaters, a Scalemaster Anti-Sea Scale unit, and other equipment. Each set is completely independent of the others and will produce 540,000 U. S. gal per day or a total output of 2.7 million gal per day. The distillate is passed over coral limestone and aerated at a "Coral Dissolver" to raise the pH from 5.5 to 7.2 and chemically treated to raise the pH further to 8.3 and improve the taste.

The cost is expected to be less than $1.75 per 1000 gal depending on the electrical demand, still considerably higher than the 10 to 50 cents average for treated fresh water in the United States.

Below, **five sets of Sextuple Effect Evaporators convert sea water to fresh water in a new $10-million plant on the island of Aruba. Fresh water will be plentiful enough to be used, *right,* for growing fresh fruits and vegetables in a 12-acre hydroponics farm.**



Corrosion Research

A CORROSION-RESEARCH laboratory for customer-application problems and alloy design and development has been opened by Carpenter Steel Company, Reading, Pa. The laboratory occupies 1500 sq ft in a building devoted to physical testing, metallurgical development, heat-treatment studies, and chemical laboratory and other facilities.

Research will be of three principal types: (*a*) On the mechanism and kinetics of corrosion, for better understanding of the phenomenon as an aid in developing and modifying alloys; (*b*) for the development of data, or limits of use in application studies; (*c*) quality control. The increase in special requirements, as far as resistance to corrosion is concerned, has made the laboratory necessary, and corrosion research will represent about one fifth of the company's research effort.

The new facility has six major types of equipment, four of which are considered unique in the specialty-steel industry: (*a*) Heat-transfer apparatus; (*b*) a Corrosometer; (*c*) a multiple-sample tester; (*d*) electrochemical equipment; (*e*) high-pressure elevated-temperature corrosion testing equipment; (*f*) stress-corrosion-cracking equipment.

The heat-transfer apparatus developed by Carpenter determines corrosion rates significant to the design of heat exchangers more accurately than previous test methods. Corrosion rates are determined by weight-loss measurements on a sample which can be maintained at a temperature different from that of the corroding solution. The actual relationship between the metal walls of a heat exchanger and the corrodent handled is thus more closely represented. Edge effects are eliminated because the sample, which is clamped over the opening in a glass vessel, is exposed only on the surface. The sample is electrically and externally heated so that heat is transferred through it into the corrodent contained in the vessel. The temperature of the solution is independently regulated by an auxiliary heating element surrounding the glassware. Tests can be applied to all aqueous chemical solutions and to all heat exchangers operating between 140 and 392 F (60 and 200 C).

The company is particularly interested in extending the range of stainless steel which has enjoyed a monopoly of use in areas where oxidizing corrosion predominates, but has been weak in resistance to acid and other of the more difficult corrosives. The corrosion rate with 25 weight per cent H_2SO_4, for example, at 170 C is twenty times that at 110 C. Many high-temperature high-pressure applications are awaiting materials development.

The comparative corrosion resistance of various alloys is being measured by the Corrosometer. This is an extremely precise instrument which measures corrosion rate in terms of microinch penetration by plotting the change in electrical resistance as the cross section is reduced by corrosion.

The mechanism and kinetics of pitting and other forms of preferential attack are being studied to measure the limits of the corrosion resistance which are largely determined by electrochemical behavior.

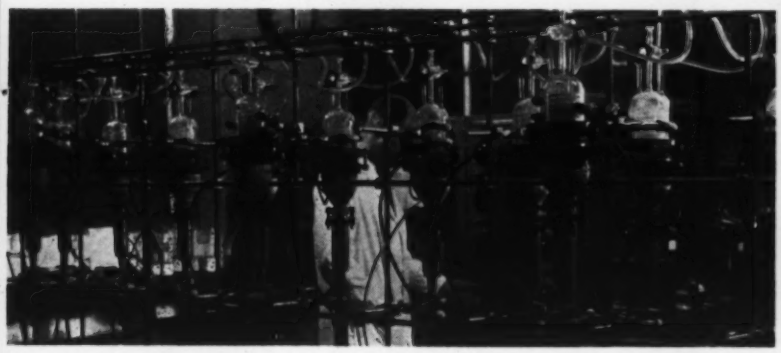
Specialized equipment and techniques are being used to determine the difference or similarity in the mechanism of stress-corrosion cracking of martensitic and austenitic stainless steels. Residual stresses are being measured by x-ray diffraction, and applied stresses are carefully measured and calculated by specimen deflection in special jigs. Stressed samples are then exposed to accumulated stress-corrosion-cracking media and the time to fracture is measured.

The special multisample tester which Carpenter has designed performs the standard ASTM boiling-nitric-acid test but overcomes several problems encountered with the usual method. Up to 36 samples may be exposed simultaneously and corrosion products are continuously removed from the acid in the sample-chamber area.

A stainless-steel autoclave with a Carpenter-designed temperature-recording and controlling system that can be operated up to 3000 psi and 750 F permits static exposure of metals to high-temperature and high-pressure steam or liquid corrodents. The laboratory is one of four qualified to make high-pressure autoclave tests and is currently testing zirconium alloys for fuel-element cladding in boiling-water type nuclear reactors.

A number of significant discoveries have already resulted from corrosion studies in the new laboratory and will soon be published.

Below, **a bank of heat-transfer-test units in Carpenter Steel Company's new corrosion-research laboratory. Carpenter developed these units which permit sample and corrodent to be heated to different temperatures.** ***Right,*** **making adjustment on the Corrosometer.**



Timken Roller Bearing Company's railroad-bearing plant: 1 The cup and cone heat-treating department—two quench presses are just behind the rotary hardening furnace; behind those are the low-temperature draw furnaces and NX and RX generators; high-temperature draw furnaces, carburizers, and connecting conveyers are to the left. 2 Operator probes the circuits to find the trouble with a furnace indicated on the Barnes panels which serve as a control center for all furnaces. 3 A line of grinding machines. 4 Monitor panel for the cone-grinding line. 5 Federal automatic air gage simultaneously checks the stand, taper, and counterbore diameters of each end of the finished-ground cup and etches a serial number on those within tolerances. 6 The final cone assembly takes less than a minute on this machine.

Timken Railroad-Bearing Plant

THE Timken Roller Bearing Company has built a 200,000-sq-ft railroad-bearing production line at Columbus, Ohio, with automatic handling devices and capable of producing 20,000 car sets of bearings a year. To date $7,150,000 has been invested in buildings and equipment to produce five standard sizes of company-developed roller bearings for freight cars. The railroad-bearing production line is divided into three major units: green machining, heat treating, and grinding.

The $10^{5}/_{8}$-in. special single-spindle automatic screw machines for green machining were designed and built by the National Acme Company in co-operation with Timken Company engineers. Equipped with seven tools, the automatic screw machines turn, bore, and cut the green race from 6 to 10-in-OD seamless tubing. Tools for the automatics are preset and preground.

Next, the other end of the green piece is machined on 12-in. National Acme Chuckmatics, at cutting speeds from 465 to 475 fpm with a feed of 0.010 in. per revolution for turning and boring, and 0.005 in. for cutoff.

After washing and marking the product is next transferred on pallets to the heat-treat department. The complete heat-treatment unit, including furnaces, quench presses, and all handling equipment, was designed and built by the Surface Combustion Corporation in co-operation with Timken Company metallurgists, heat-treatment specialists, and engineers. All furnace operations have controlled atmospheres and the product when ready for grinding is completely clean and free from scale.

After heat-treatment, a spiral-elevator feeder delivers the rollers to the grinding line at the rate of 38 per min. Here, first and second-pass body grinds on #3 centerless grinders each remove approximately 0.010 in., ends are ground flat and parallel on the rollers of an #84B Gardner grinder, the large end of the rollers is spherical end ground on four Timken-designed special grinders, and third and fourth-pass body grinds on #3 centerless remove 0.003 in., and 0.0015 in. Gages in the conveyer line check roller size and length and automatically control the compensation for wheel wear.

Green, yellow, and red overhead lights tell the operator at a glance if a machine is operating, in operating condition but waiting for some reason, or stopped and requiring attention. The same information is also available in more detail at a monitor panel.

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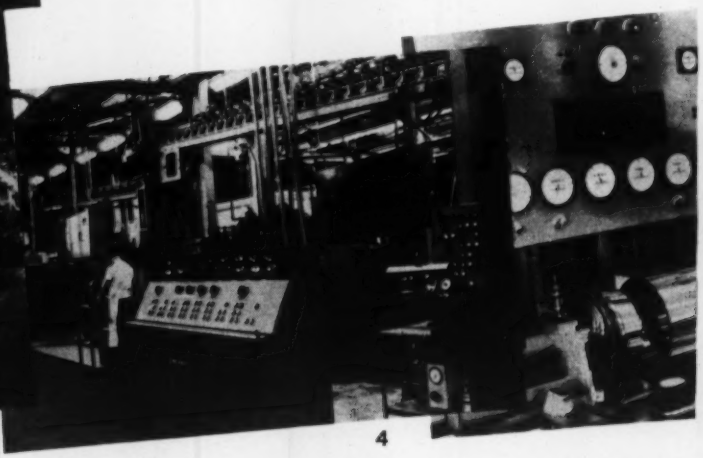

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Heat-treated cups are delivered to the hard-stock area at the west end of the grinding line on pallets and manually loaded into a storage conveyer ahead of the first of eight grinding operations. All cup-grinding machines are equipped with gages which give in-process control at each operation. Additional gages are provided for quality-control checks by roving inspectors.

The conveyer system provides automatic handling and positioning of cups between operations, eliminates damage by contact between heavy cups, and provides for 3-min storage of parts between operations. Washing stations in the bottom of each elevator clean and cool the cups after each operation.

After final inspection for defects and dimensional accuracy, both cups and cones are conveyed through an automatic phosphating operation which gives all surfaces a protective coating against rust.

In the final assembly area, cones, rollers, and cages are brought together and automatically assembled, and the cage closed in to make a self-contained unit. Assembled cones are then conveyed to a battery of machines where they are run in under load. During this operation the cone is flushed with filtered oil to remove any remaining foreign matter. After running in, a visual inspection checks cage clearance.

At the final assembly station, one cup and two cones are assembled with a spacer of known length and checked for lateral clearance on a rotating air-operated fixture. Cone assemblies are then greased and reassembled with the proper production spacer indicated by the lateral check, a metered amount of grease is added, and grease seals are pressed into the cup.

Seal wear rings, cone backing rings, and axle end caps are then banded to the assembly with the proper protective paper board and placed in a box and the box sealed.

When the correct number of assemblies has accumulated on a wooden pallet, the boxes are banded to the pallet, and the loaded pallet is moved away on a conveyer.

The pallet loads of bearings are moved by special truck and placed in steel racks to await shipment to the customer.

Timken recently completed a large roller-bearing production plant for the automotive industry at Bucyrus, Ohio (MECHANICAL ENGINEERING, October, 1957, pp. 981–986).

5 6

Water-Cooled Stator Windings

GENERAL ELECTRIC COMPANY is building the nation's first steam-turbine-driven generator with water-cooled stator windings—a new design which affords the possibility of generator ratings conceivably as high as 1,000,000 kva.

Water cooling will be used in the two 265,000-kva generators of the 450,000-kw, cross-compound steam-turbine-generator unit being built by the Company's Large Steam Turbine Generator Department for the Philip Sporn Plant of the American Electric Power System at Graham Station, W. Va. The plant is jointly owned and operated by Appalachian Power Company and the Ohio Power Company, two operating subsidiaries of the American Electric Power Corporation.

Water cooling should result in not only double the generator ratings now possible with conventional cooling within the same frame size, but also significant savings in power-plant construction costs. In addition, much higher-rated generators can be built and installed within the limitations on physical size and weight presently imposed by current shipping restrictions.

The 450,000-kw 3600/3600-rpm, cross-compound, six-flow turbine-generator unit is similar to another 450,000-kw unit being installed at the Breed Plant of the Indiana and Michigan Electric Company, also of the AEP System. Unlike the Sporn unit, the latter will have oil-cooled stators. These units will be the largest capacity machines in the history of the electric power industry at the time of their completion. Each will be theoretically capable of supplying the residential electric requirements of a city with a population of 4 million and will consume 150 tons of coal at full load every hour.

Radiochemical Laboratories

Two NEW radioisotope-tracer laboratories have been established to aid mineral research at the U. S. Bureau of Mines installations in Reno, Nev., and Salt Lake City, Utah.

Radiotracer research now under way at Reno seeks new information that can lead to more efficient methods for extracting and separating the rare earths, a family of metals with important uses in industry and defense. In addition, so-called "activation analyses" are being made to detect traces of impurities in extremely pure metals, also known as hyperpure metals.

At Salt Lake City, Bureau metallurgists will use various radioactively "tagged" chemicals, compounds, and minerals to find out what reactions occur in such metallurgical processes as roasting and flotation used in extracting metals from their ores.

Pioneering studies on the use of radioactive materials in mineral research began in 1951 at the Bureau's Petroleum Experiment Station in Bartlesville, Okla., where research is conducted on radioisotopes that are placed in water pumped underground to force oil toward producing wells. These radioactive tracers are used to determine how efficiently the water-flood system is operating.

The two new laboratories were built according to specifications approved by the Atomic Energy Commission. Research now in progress and studies planned for the immediate future will employ isotopes that have a low level of radioactivity permitting flexible operating procedures with little or no shielding for workers.

Servomechanism Building Blocks

SERVOMECHANISM "building blocks" which may be quickly and easily arranged in a variety of combinations to perform measurement and control functions are available in an integrated line of off-the-shelf Mechatronic Development Apparatus, MDA, made by Servomechanisms, Inc., Westbury, N. Y.

All of the components have been produced in quantity and have proved their reliability in control applications. They may be combined into breadboard models for system development to eliminate complicated initial development calculations and costly design changes. Modulators, power supplies, amplifiers, servomotors, potentiometers, synchros, and resolvers are but a few of the standard components that are available.

To develop a servo, the control problem is studied, the variables to be measured and controlled, and their ranges and tolerance requirements are established, and a block diagram is prepared. After selection of suitable transducers and the amplifier-motor combination, a simplified mechanical schematic is prepared using the outline dimensions of basic MDA parts.

The components are then assembled and interconnected in accordance with the mechanical schematic and the system block diagram. Optimum performance can be achieved by making experimental adjustments of the factors which affect servo performance. Adjustments can be made to gear ratios, controller gain, stabilization networks, output inertia, and damping devices.

Foundation boards, bearing blocks, mounting blocks, shaft gears, clutch assemblies, and numerous other parts are available individually or in kit form.

Proved functional units for control systems may be chosen with the same ease with which engineers select vacuum tubes, valves, and pumps. Each of the functions that a servomechanism can perform has usually been done before to some degree by less sophisticated means, but packaged units provide high-quality, high-performance units at minimum cost.

Boron Fuels Plant Built

A FULL-SCALE production plant for high-energy fuels built by the Olin Mathieson Chemical Corporation for the Navy—the service that originated research of boron fuels—began operation recently near Niagara Falls, N. Y.

Shipments from the facility will be made to both the Navy and Air Force. The Navy's portion of the fuel will be used for further development work.

The Navy plant built at a cost of $\$4^1/_2$ million will mix boron, hydrogen, and other chemicals to produce High Energy Fuel-2. Construction continues on a $45-million Air Force plant nearby for completion some time next year.

The fuel is the result of five years of research and two of production testing and gives considerably more Btu's per lb than the 18,500 of aviation gasoline. It has been manufactured in small laboratory pilot units by Olin Mathieson since 1952. Other high-energy fuels under development can further increase the range of air-breathing engines as compared with the best current jet fuels. The price of the fuel is still classified, but the company predicts that large-scale production prices will be moderate and within a range that permits their extensive use for commercial applications.

A portion of the control panel that monitors the production of high-energy fuel at Olin Mathieson's new plant near Niagara Falls, N. Y.

Nuclear Briefs

▶ Transient Behavior of Fuel Elements

A $1-MILLION Transient Reactor Test Facility, TREAT, for investigating the effect of extreme nuclear conditions upon fast-reactor fuel elements, will be completed this year at the AEC's National Reactor Testing Station near Arco, Idaho.

It is being designed by Argonne National Laboratory, Lemont, Ill., and will be operated by Argonne's Idaho Division.

TREAT is designed especially to deliver a high-intensity short-duration pulse of nuclear energy, similar to that occurring during nuclear excursions, without damage to the facility itself. The pulse will cause intense heat to be generated in the sample under test, and is believed to be greater than that which can be safely attained by any other nuclear reactor.

▶ Commercially Available Reactor Facilities

Irradiation space and experimental facilities in the 30,000-thermal-kw General Electric Test Reactor, GETR, which will be completed this year at the company's Vallecitos (Calif.) Atomic Laboratory, will be made available on a commercial basis to other industrial, educational, and research organizations, both private and government.

The $4-million facility is the first large test reactor to be placed in operation by private industry and the fourth specialized nuclear facility at Vallecitos. It is designed for conducting engineering tests on fuel elements and components of nuclear plants and for furnishing high neutron-irradiation fluxes. It will be suitable for research in basic nuclear physics, and for use in materials-development programs being carried on in the rubber, chemical, metal, petroleum, plastics, and electronics industries.

Materials Briefs

▶ Electrically Conductive Paper

ELECTRICALLY CONDUCTIVE paper built up of metal fibers in the same fashion as paper made from wood pulp has been developed at the Hurlbut Paper Company, South Lee, Mass., according to the *Industrial Research Newsletter* published by Armour Research Foundation. It also resists extreme temperatures, has magnetic properties, and conducts heat. The most successful types resemble metal foil and have been combinations of metal, synthetics, glass, or paper.

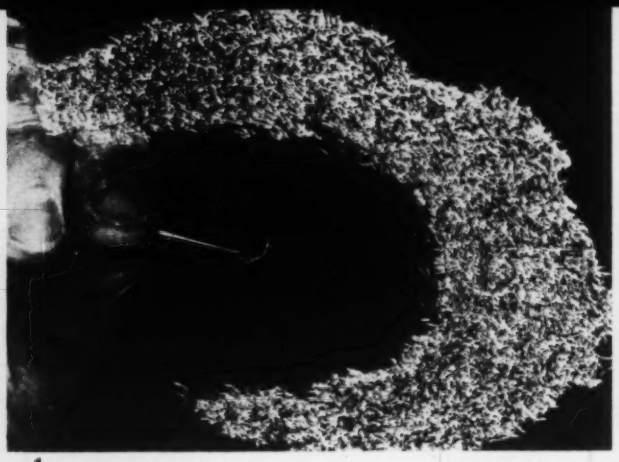
▶ Ferromagnetism Without Ferromagnetic Elements

Ferromagnetism at low temperatures has been discovered in an intermetallic compound which does not contain any of the commonly known ferromagnetic elements. B. T. Matthias at Bell Telephone Laboratories, made the discovery while studying the properties of a zirconium-zinc compound, $ZrZn_2$, at low temperature.

Previously no ferromagnetic intermetallic compound was known that did not contain any ferromagnetic elements—iron, cobalt, nickel, chromium, manganese, or a few rare-earth metals.

The behavior of zirconium zinc indicates that ferromagnetic and perhaps antiferromagnetic compounds may be formed by the combination of many more metals than had been supposed until now. Thus the discovery opens up an entirely new field for exploration.

Zirconium zinc becomes ferromagnetic below 35 K. Its ferromagnetic characteristics are similar to and of the same order of magnitude as those exhibited by conventional ferrites at room temperatures. Discovery of these properties provides a powerful new tool for the study of the fundamental characteristics of magnetism and magnetic materials.



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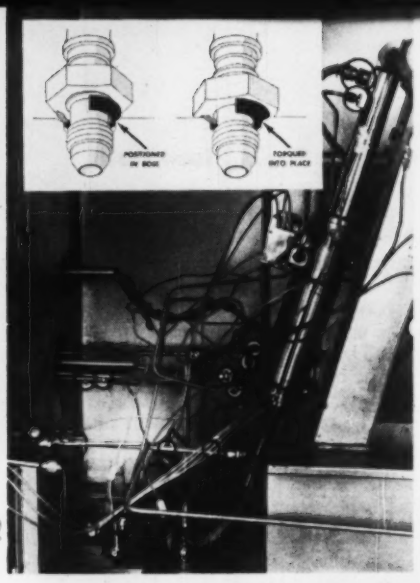

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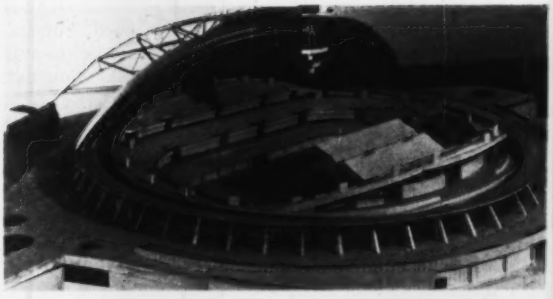
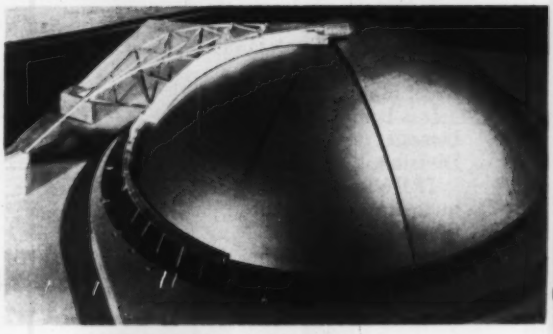
1 Granular Aluminum. Bridging the gap between expensive powder and minus-five-mesh shot is a new coarse granular aluminum produced by Reynolds Metal Company, important for solid-fuels and chemical-process technology. Special sizes can be made to order but 300 X (0.132 to 0.02 in.) and 200 X (0.08 to 0.01 in.) are now being produced.

2 Deforming Seal. A simple seal made of aluminum, stainless steel, or Inconel-X deforms and becomes an integral part of the fitting with application of torque. Sealing is effective from −360 F to +1200 F, depending on material used, and from 0 to over 10,000 psi. **3 Stainless-Steel Movable Dome.** Pittsburgh's $20-million Civic Arena will have a mammoth 415-ft-diam domed roof with six movable and two stationary Type-302 stainless-steel sections. The open-air stadium which seats 14,000 can be weatherproofed by pressing a button to close the dome. Ammann & Whitney of New York, N. Y., are engineering consultants on the design of the roof—first of its kind. **4 Expanding Mandrel.** Expansion to 0.0015 in. above the height limit from a diameter which is 0.0015 in. below the low limit improves the alignment of the housings for speed reducers. Assembly begins by placing the reducer head on a special fixture with ground locating surfaces for the four mounting pads. The mandrel with built-up chucking surface is then inserted in the through-shaft bore, the frame placed over it, and the cap-screw holes in the flange lined up. Following tightening, a ground plug is inserted in the drive-shaft holes before lining up the seal bores in the formed housing. Bushings are slipped over mandrel and plug to fix center distance. **5 Rocket Jump.** Infantrymen have leaped distances up to 20 ft while carrying up to 30 per cent of their own weight with the aid of these rocket-powered jump belts made by Reaction Motors Division of Thiokol Chemical Corporation, Denville, N. J. The small nozzles located at the hips do not interfere with normal actions. **6 Trackless Train.** Fifth trackless train to be built by R. G. LeTourneau, Inc., of Longview, Tex., will operate on electric motors geared directly to the rim of each of the train's 52 wheels. A unique steering arrangement assures that the last car of each 450-ft. 2000-hp train will follow the tracks of the first. "Walking beam" and "oscillating axle" suspension, assisted by 10-ft-high by 4-ft-wide tires provides smooth boatlike riding characteristics.





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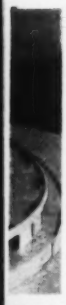

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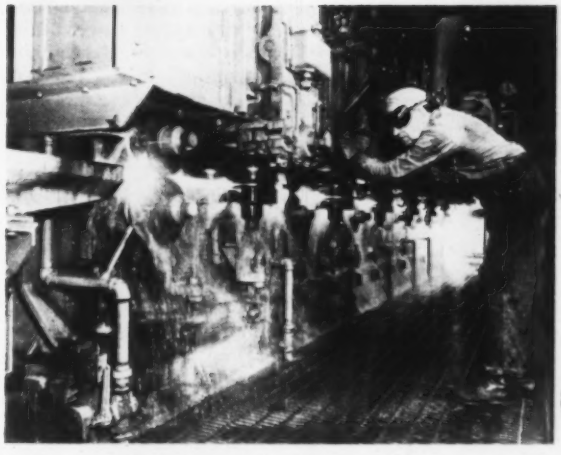

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7 Elevated - Temperature Tests. This universal machine handles tension, compression, creep, and fatigue tests on full-size ASTM specimens to over 3000 F with a capacity of 0 to 50,000 lb. Electronically controlled servos automatically subject the specimens to any combination of rates of loading, elongation, and temperature. Ram rates up to ¾ ips, temperature rises of 200 deg per sec, and cyclic rates of 10 cps are possible. The machine automatically plots a complete stress-strain curve on a single 8½ x 11 graph, and is made by Marquardt Aircraft Company. **8 Continuous-Weld Pipe Mill.** Jones & Laughlin's monthly rated capacity for welded pipe has increased to 35,000 net tons with construction of two new continuous-weld pipe mills at a cost of $17 million.

PHOTO BRIEFS

Engineering Progress in the British Isles and Western Europe

J. FOSTER PETREE
European Correspondent

EUROPEAN SURVEY

6-Ft Hole Bored in 2 Minutes

THE people of this present age promise to go down in history as the great putters-up of poles. Europe bristles with them; and the more industrially advanced the country, the more poles it puts up. To accelerate the process, the Wilhelm Wittenburg Maschinenfabrik, of Hamburg 48, West Germany, has produced a portable hole-borer which can be towed behind a truck and driven from its power take-off. It was being demonstrated at the German Industries Fair in Hanover by Baas G.m.b.H., of Berzeliusstrasse 59, Hamburg 48, and showed itself capable of boring a hole 2 ft diam and 6 ft deep in average soil in 3 min or less. In light soil the time can be brought down to 2 min. It consists of a two-wheeled trailer on which is mounted a light jib of steel tube, carrying a gearbox from which depends the screw auger. This has two cutting edges to bite into the ground, but only one is continued upward to form the helix for lifting the excavated soil, so that there is no risk of compressing the earth again and clogging the auger. The drive to the gearbox is through a primary gearbox on the frame of the machine, in which is housed an oil-hydraulic pressure pump for raising and lowering the jib. For towing, the auger is swung in under the jib and its end secured to the frame. In one model the jib is extended to form a light crane which can be used to lift and set the pole after the hole has been bored.

Portable hole borer is capable of boring a hole in light soil 6 ft deep and 2 ft in diam in 2 minutes

Heavy-Duty Rock Crusher

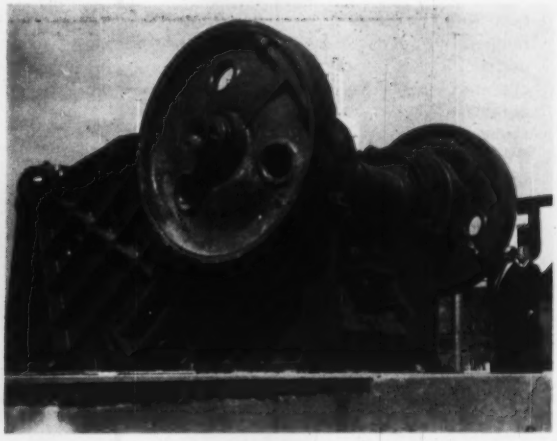
A ROCK crusher of exceptional size was exhibited at the German Industries Fair by the Fried. Krupp Maschinen- und Stahlbau, of Rheinhausen; its feed opening measured 1700 mm × 1250 mm (67 in. × 49 in.) and it is driven by two motors of about 150 hp each. The upper jaw is fixed and the lower jaw swings about a cross shaft at its upper end, immediately below the feed opening.

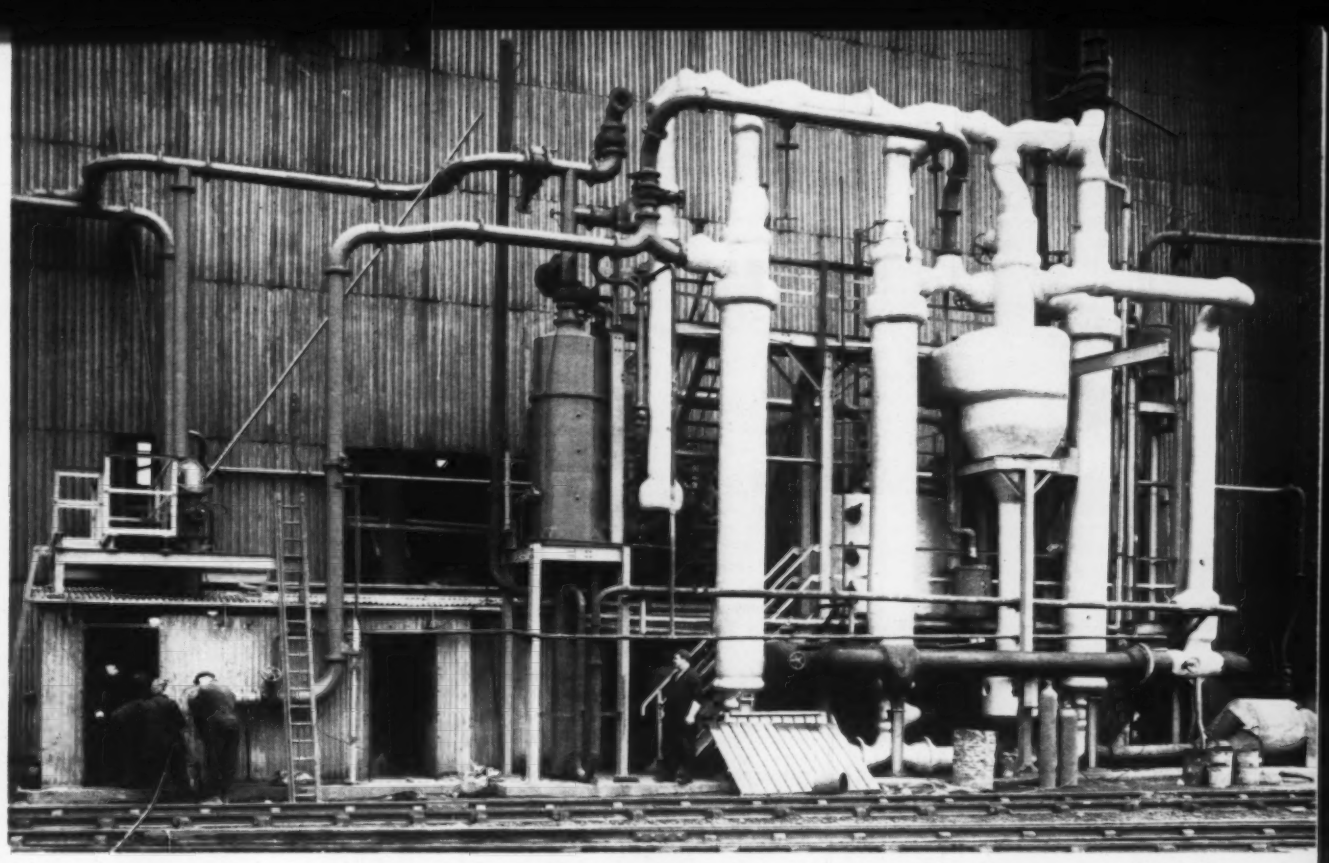
The swinging motion is imparted by two side rods reciprocated by eccentrics. The side rods, however, are not attached directly to the eccentrics, but are connected to them through heavy coil springs to prevent overloading. The cast steel cheek on the swinging jaw is curved at its lower end so that the rate of flow of the material increases toward the outlet; and the movement of the lower end of the jaw is so rapid that the crushed rock cannot follow it; hence the percussive action, which hurls the stones against the fixed cheek and keeps the material in a loose state, so preventing choking of the discharge passage. The eccentrics are carried on large-diameter roller bearings.

The crusher jaws are made of 12 to 14 per cent manganese steel. They are interchangeable and symmetrical, so that they can be reversed. The machine on exhibition was for delivery to a German limestone firm, the Rheinisch-Westfalisch Kalkwerke A.G.

Correspondence with Mr. Petree should be addressed to 39 Mayfield Road, Sutton, Surrey, England.

Percussion heavy-duty rock crusher has a feed opening 67 in. × 49 in. and is driven by two motors each of 150 hp





Combined desulfurizing and sulfuric-acid pilot plant in operation for two years at The United Steel Companies, Ltd., Appleby-Frodingham Steel Company, Sheffield, England. Up to 3-million cu ft of coke-oven gas per day are purified. Essential components of plant are fluidized hot iron-oxide absorber and regenerator.

Desulfurizing and Sulfuric-Acid Plant

THE use of coke-oven gas to fire open-hearth melting furnaces, which is customary in large integrated steel plants, introduces difficulties in the making of low sulfur steel as the gas contains about one per cent of sulfur; and it also presents problems in atmospheric pollution because of the large quantities of SO_2 which are released. The Appleby-Frodingham Steel Company, a branch of the United Steel Companies, Ltd., Sheffield, England, who operate one of the largest steelworks in England, have been working on the problem of efficient desulfurizing for a number of years and have now developed a new type of combined desulfurizing and sulfuric-acid plant which they claim to represent a major advance.

The pilot plant illustrated has been in successful operation for two years, purifying up to 3-million cu ft of coke-oven gas per day. It consists essentially of a fluidized hot iron-oxide absorber and regenerator, capable of reducing the content of both hydrogen sulfide and organic sulfur to very low levels and of recovering considerable quantities of sulfuric acid.

It is claimed that, in a steel works making a million tons of ingot steel a year, the use of a plant of this type will enable as much as 250 tons of sulfuric acid to be produced each week. The heat requirements of the recovery plant are met by the combustion of the absorbed sulfur so that, once started, the process is self-sustaining. Because it employs hot gas, it is much faster than iron-oxide boxes or purification towers; and use of fluidized beds reduces the amount of spent oxide by 80 per cent.

A full-scale plant is now under construction at the Appleby-Frodingham works and is due for completion in about twelve months from now. It is being built by W. J. Fraser & Company, Ltd., of Romford, Essex, England, who, with the firm of Henry Balfour & Company, Ltd., of Leven, Fife, Scotland, have been appointed by Appleby-Frodingham as licensees. When completed, it will be able to deal with 32-million cu ft of gas per day, and will need only two men per shift to operate it.

Spirally Welded Pipe

A STRIKING new exhibit at the recent German Industries Fair at Hanover was a spirally welded steel pipe 28 in. in diam and nearly 160 ft long, shown by the Hoesch Rohrwerke A.G. of Hiltrup, Westphalia. One end of the 8-mm steel strip was unwound and was welded to the end of a new coil, mounted on a stand in the approximate position that it would occupy in the construction of the pipe.

As it is uncoiled, the strip passes through leveling rollers and is trimmed along both edges by pairs of wheel cutters, one pair above and the other below the strip. Finally it passes between a pair of feed rolls and so to the pipe, where it is welded simultaneously inside and outside of the seam by the Ellira automatic submerged-arc process. The test pressure of the pipe exhibited was 75 atm (1060 psi). The standard sizes of pipes made by this process are from 20 in. to 46 in. in diam and can meet all the requirements of the API standards.

Substance in Brief of Papers Presented at ASME Meetings

M. ZANFARDINO
Staff Editor

ASME TECHNICAL DIGEST

Power

Pulverized-Coal Transport Through Pipes.....58—SA-24

By R. C. Patterson, Mem. ASME, Combustion Engineering, Inc., Chattanooga, Tenn. 1958 ASME Semi-Annual Meeting paper (multilithographed; to be published in *Trans. ASME;* available to April 1, 1959).

Firing of pulverized coal in progressively larger steam generators has posed several problems to the designer of pulverized-coal-handling systems over the years. Methods of firing have changed, and simple extrapolation of the transport techniques for relatively small units of 25 yr ago either were not feasible or were uneconomical for the large units and new firing methods used today.

Typical of the problems encountered in pulverized-coal transport are: Capacity selection of exhausters; line balancing when two or more transport pipes are used in parallel; optimum transport velocities to permit line balancing while at the same time minimizing erosion of the pipes; control of uniformity of splitting of primary air and pulverized-fuel streams when one transport pipe is divided into two or four or more separate pipes; and actual measurement, in commercial installations, of air velocities and pulverized-coal weight rates for the mixture flowing through individual pipes of a parallel arrangement.

With the general objective of obtaining practical answers to the foregoing problems, a test program was proposed and undertaken to obtain usable engineering information.

The investigation has provided information relative to the performance of a commercial-type exhauster handling air-coal mixtures; friction factors for 8 and 12-in-diam pipe handling air-coal mixtures; general information as to the flow characteristics of air-coal mixtures in various piping systems; methods and means for measurement and control of coal drifting in horizontal pipe; and a method for air-flow measurement in mixtures. Friction factors in the range of 0.017 to 0.035 for 8 and 12-in. pipes are indicated for the usual operating range.

Operating Results of an Experimental Supercritical Steam Generator.....58—SA-17

By E. Daman, Mem. ASME, H. Phillips, Assoc. Mem. ASME, J. Vail, and S. Ling, Assoc. Mem. ASME, Foster Wheeler Corporation, New York, N. Y. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

In order to obtain information needed to design once-through central station steam generators, operating at subcritical and supercritical steam conditions, a pilot plant was erected and operated at the Carteret Laboratory of the Foster Wheeler Corporation.

This paper presents some of the results achieved with a 2000-lb per hr supercritical pilot plant after 5000 hr of operation. Data on water side conditioning and the effect of final steam temperature on corrosion rate are presented. The paper also describes a successful automatic control system which was developed. Tests and test results from control runs are presented and it is shown how these results can be applied to the design of central station once-through steam generator control systems.

Availability Balance of Steam Power Plants.....58—SA-16

By C. A. Meyer, Mem. ASME, G. J. Silvestri, Assoc. Mem. ASME, and J. A. Martin, Assoc. Mem. ASME, Westinghouse Electric Corporation, Philadelphia, Pa. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

The well-known expression for availability, $b = h - T_0 s$, is developed in a simple yet general manner. The changes in availability throughout several typical single and double reheat steam plants having different steam conditions have been calculated. Balances of availability are presented for each of the several plants. These balances show the net plant output as the difference between the availability added in the boiler and the various losses in availability throughout the plant.

The maximum plant thermal efficiency (or minimum heat rate) is easily obtained from the ratio of the increase in availability to the heat added in the boiler.

The availability balances present in fine detail the loss distribution throughout the plant. Some very interesting results are obtained. For example, an assumed average plant will have a calculated maximum thermal efficiency of about 75 per cent based on the ratio of the availability and the heat in the high temperature combustion gases. Due to the heat transfer through a temperature difference, this value is reduced to 50 per cent when based on the ratio of the availability and the heat added to the steam in the boiler. This average plant will lose an additional 10 points in thermal efficiency, due to internal losses in availability, resulting in a 40 per cent thermal efficiency (excluding boiler and auxiliary losses). These latter 10 points due to internal losses are roughly divided as follows:

Pressure drop	0.9
Turbine blading	5.0
Turbine leakage	0.6
Turbine leaving and hood	1.0
Mechanical and generator	0.7
Feed heating system and Feed pump and motor inefficiency	1.3
	0.5
	10.0

An availability balance enables one to make an accurate assessment of the losses in any power plant and therefore serves as a very accurate guide in directing development effort toward reducing the more significant losses.

A Review of Engineering Considerations for the River Rouge Power Plant.....58—SA-10

By G. A. Porter, Fellow ASME, and W. L. Wingert, Mem. ASME, The Detroit Edison Company, Detroit, Mich. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

One of the notable achievements of the power industry has been the continued improvement in power-station economy over the past 40 years. This is exemplified by comparing the fuel consumption of the Conners Creek Unit No. 4, Detroit Edison Company, installed in 1918, having a fuel consumption of about 1 1/3 lb of coal per kwhr compared to the expected rate of 0.7 lb of coal per kwhr for River Rouge No. 3. Some of the design improvements and considerations leading to this improvement are discussed in this paper.

In the same period, unit size has increased rapidly to meet the rapid growth in demand. Again comparing, Conners Creek No. 4 is a 40-mw machine and River Rouge No. 3 a 320-mw machine. The industry is continuing the effort to reduce costs by careful engineering study. Size increase has been a large contribution to this effort.

The power industry has done an outstanding job of holding rates down in the face of rising costs. Improved economy and reduced first cost have been major factors in this achievement. River Rouge Power Plant is an example.

Progress is rarely achieved, however, without accompanying difficulties. Problems encountered with the design, construction, and operation of the River Rouge Plant are discussed, with no intent to discredit suppliers but to relate these troubles for whatever assistance it may be to other power engineers and manufacturers.

Design of 321-mw Cross-Compound Steam Turbine—River Rouge Unit No. 3.....58—SA-22

By C. D. Wilson, Mem. ASME, Allis-Chalmers Manufacturing Company, Milwaukee, Wis. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

The Detroit Edison Company was the first public utility to order a steam turbine-generator unit in the 300-mw size range. This first machine has a nameplate capability of 321 mw and is installed as the No. 3 unit in the River Rouge Station. It is a close-coupled cross-compound 3600/1800-rpm design similar to many smaller cross-compound units of the author's company in service since 1953. The machine is designed for operation with subcritical pressures and with steam temperatures that permit using ferritic materials.

However, the much larger rating of the River Rouge machine created many new design problems that required extensive study and investigation. Major problems included the efficient handling of the large volume steam flow while keeping floor space requirements to a minimum.

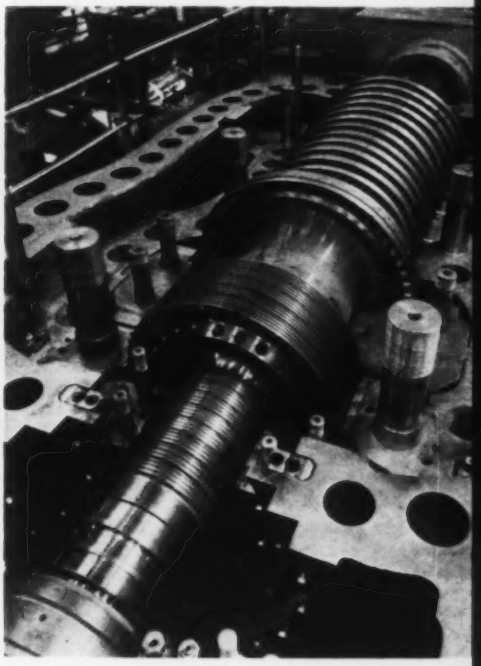
The preservation of the same degree of operating stability in a large machine that is presently available in the smaller conventional units had to be maintained as well as the ability to ship and service the larger components without difficulty. This paper describes how these requirements have been satisfied in the design of the No. 3 machine for River Rouge.

The Control System of a 225,000-kw Double-Automatic Extraction Steam Turbine and Related Reducing Stations.....58—SA-36

M. A. Eggenberger, Mem. ASME, and P. G. Ipsen, Mem. ASME, General Electric Company, Schenectady, N. Y. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

Three variables must be controlled on a double-automatic extraction turbine—speed (or power output), and the two process-header pressures, by controlling the flow of steam at different pressure levels. This has been done in a satisfactory manner on a large number of extraction turbines. However, the designs which had been developed for turbines of 50,000-kw capacity and smaller were not suitable for a turbine nearly five times as large, and a completely new control-system design had to be created.

Aerial view, *left,* of Detroit Edison Company's River Rouge Plant. (58—SA-10) Offset parting joint, *right,* on high-pressure turbine of River Rouge Unit No. 3 provides center-line support for high-pressure turbine on all four corners. (58—SA-22)



Flow Modulator for K-F Direct-Contact Regenerative Heater System... .....58—SA-48

By H. A. Kuljian, Fellow ASME, The Kuljian Corporation; and H. S. C. Chen, Drexel Institute of Technology, Philadelphia, Pa. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

The type K-F feedwater heater uses standard tray-type open heaters and a deaerating heater which are combined in a vertical tower. The heat rate for the regenerative cycle when using the F-K feedwater heater combined with a closed heater is better than that of the same cycle employing conventional closed heaters.

This paper gives the outstanding features of the K-F heater, and discusses the control problem.

The development of a flow modulator which solves the control problem is described, and possible applications are suggested.

Modern steam plants, by use of the modulator for the K-F open feedwater heater, can do away with a complicated interstage control system.

A mathematical analysis is shown with curves for 100 and 25 per cent load on a 150,000-kw unit. Outlook is for a simplified, less expensive, and more efficient central station; therefore, electricity at less cost.

Electrostatic Shaft Voltage on Steam-Turbine Rotors...58—SA-5

By J. M. Gruber, Mem. ASME, General Electric Company, West Lynn, Mass.; and E. F. Hansen, General Electric Company, Schenectady, N. Y. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

Several different types of shaft voltages can be present on steam-turbine rotors. The one type that has gained increased significance in the past five years is the direct-current or electrostatic voltage. Prior to this period, electrostatic shaft voltage had not been a problem. This voltage has been causing damage to different turbine parts and, without warning to turbine operators, has been responsible for a number of serious turbine outages. The investigation which was undertaken by the authors was the result of a number of unexplainable bearing failures. The investigation showed that the cause of these failures was due to a static voltage generated in the steam turbine. The solution to the problem is to ground the turbine shaft. This has eliminated the turbine shutdowns caused by bearing failures resulting from electrostatic voltage.

Heat Transfer

The Thermal Conductivity of Aluminum Honeycomb Material Near Room Temperature.....58—SA-1

By R. V. Dunkle and J. T. Gier, University of California, Berkeley, Calif.; and J. T. Bevans, Assoc. Mem. ASME, Shell Development Corporation, Emeryville, Calif. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

Honeycomb is a general term used to describe a material composed of two thin facing sheets separated by a hexagonal core structure. The core and faces are held together with an adhesive to form a material with a high strength-to-weight ratio. The resulting structure is nonhomogeneous and anisotropic.

Thermal-conductivity tests were made on a series of aluminum honeycomb panels. Thermal resistances were correlated in terms of honeycomb-cell geometry and type of adhesive bonding between core and outer skin.

The thermal resistance of the honeycomb assembly was derived on the basis of three thermal resistance elements in series, namely, (*a*) the skin, (*b*) the adhesive, and (*c*) the core. For the particular samples tested, the skin resistance was negligible. The core resistance was derived on the basis of the physical geometry and the thermal conductivity of the core material. For the aluminum honeycombs tested, the effect of the air in the core on the heat flow was negligible. The data have been correlated in such a manner that the same techniques could be used to predict the thermal conductivity of other honeycomb structures composed of different core and skin materials. If other types of adhesive bonds, different cell sizes, or lower conductivity skin materials are used, further experimental tests would be required to determine the component thermal resistances.

The results presented are for heat flow perpendicular to the face of the material. The thermal resistance of the material was determined with the upper face cooled, and the effects of free convection within the air cells would be greater for this configuration than if the bottom face had been cooled. The effect of the air circulation was negligible under the test conditions, even for the thickest samples tested. The restriction of the results to heat flow normal to the face of the material should be noted since heat flow parallel to the face is a substantially different problem.

Regenerative Heat Exchangers With Heat-Loss Consideration..... .....58—SA-29

By E. K. Dabora, Assoc. Mem. ASME, The University of Michigan, Ann Arbor, Mich. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

The differential equations describing the regenerative-type heat exchanger with heat-loss consideration are solved by using Laplace transform. The solution is carried out for two cases: (*a*) Heating the bed from a uniform initial temperature equal to that of the surroundings with fluid at constant inlet temperature, and (*b*) cooling the bed from a uniform temperature with fluid at constant inlet temperature equal to that of the surroundings. Typical curves of the transient bed temperature are included for both cases. The steady-state temperature in heating is shown to depend solely on the ratio of the heat loss and fluid heat capacity; therefore, for any heat-exchanger design where the maximum temperature that can be attained at the exit is of importance, this term should be estimated carefully.

The Calculation of Forging Cooling Rates.....58—SA-4

By D. P. Timo, Mem. ASME, and R. M. Goldhoff, General Electric Company, Schenectady, N. Y. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

Factors involved in calculating temperature distributions and cooling rates in forgings, during cooling, are discussed. An approximate method is developed for taking into account the variation of thermal properties and the surface heat-transfer coefficient with temperature. Cooling rates are calculated by this method at various radii in a 44-in-diam turbine forging and a 7-in-diam cyclinder. These calculated cooling rates are shown to be in good agreement with experimental data obtained from these two forgings.

Heat-Transfer Charts for Time-Variable Boundary Conditions, Part I—Semi-Infinite Solid.....58—SA-7

By T. J. Mirsepassi, Mem. ASME, Aerojet-General Corporation, Azusa, Calif. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

In heat-conduction studies, the evaluation of an analytical solution is often a lengthy process. Each evaluation may require finding the roots of a transcendental equation, using special mathematical tables, and computing many terms of a series. Because of this complexity,

many authors have computed, either by direct calculation or by analog experiments, the numerical values of certain analytical solutions and have presented the results graphically. The tasks have well served the purpose and have made possible the rapid solution of many problems.

There are, however, numerous other complicated analytical expressions that, although of great practical application, have not yet been worked out for a quick, easy, and accurate graphical evaluation. Duhamel's solution is one of them. This solution (first published in 1832) determines analytically the temperatures in a solid when boundary temperature varies with time. The solution, representing a very realistic condition, has numerous technical applications in engineering heat transfer.

In the evaluation of Duhamel's expression, two kinds of difficulties are involved: (*a*) those due to the usual complexity of solution of transient conduction problems, and (*b*) those due to the additional complexity introduced by the integral form of Duhamel's formula. Since the boundary-temperature function is present in the integrand of Duhamel's expression, preparation of a temperature-time chart by the existing methods is possible only after assuming some function (linear, exponential, sinusoidal, and so on) for the time-variable boundary temperature. Such a chart will not serve either for the solution of the more general and practical problem of "determining temperature in a solid when the boundary temperature is an arbitrary plotted function of time," or for "determining an unknown boundary temperature from a given temperature-time recording of a point in the solid." Charts are presented in this paper for the solution of the general problems of (*a*) determining temperature in a semi-infinite solid when the boundary temperature (or flux per unit area per unit time) is an arbitrary plotted function of time, and (*b*) determining an unknown boundary temperature (or flux per unit area per unit time) from a given temperature recording of a point in the solid.

Modified Boundary-Layer-Type Solution for Free-Convection Flow in Vertical Closed Tube With Arbitrarily Distributed Internal Heat Source and Wall Temperature.....58—SA-30

By F. G. Hammitt, Mem. ASME, University of Michigan, Ann Arbor, Mich. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

An analytical solution for heat and mass transfer in a closed, vertical, cylindrical vessel wherein heat is generated as a volumetric heat source within the fluid and removed through a cooled wall is derived. The solution is limited to laminar flow with fluids with Prandtl number of the order of unity, and to large nondimensional heat-source rates such as would be expected for aqueous, homogeneous, internally cooled nuclear power reactors. It includes arbitrary wall temperature and heat-source axial distribution.

Leakage and Elastic Characteristics of Compressed Asbestos Sheet Packing.....58—SA-28

By J. J. Whalen, Assoc. Mem. ASME, Johns-Manville Sales Corporation, New York, N. Y. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

A study is presented of the leakage and elastic characteristics of compressed asbestos sheet packing. Variables investigated were bolt load, gasket width, gasket thickness, and flange surface finish. Leakage data were correlated with respect to the *m*-value. It was found that the *m*-value is not constant and typical curves were derived from various leakage pressures and area ratios. This area ratio is the ratio of internal area to gasket area. The effect of gasket thickness and flange surface finish on the *m*-value is discussed also. The stress-strain characteristics of a typical compressed asbestos sheet were studied. From the stress-strain and leakage data, new design equations based on elastic theory were derived to predict the required total bolt area necessary to maintain joint tightness.

Rubber and Plastics

Designing With Rigid Polyvinyl Chloride.....58—SA-67

By M. Batiuk and J. A. Rolls, B. F. Goodrich Chemical Company, Avon Lake, Ohio. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

Polyvinyl chloride (PVC) has been in use since World War II when Germany used it as a substitute for metal. In the past eight years it has come into use not as a substitute material but as a material of construction in its own right. In many applications PVC will do a better job at lower cost than any other material available.

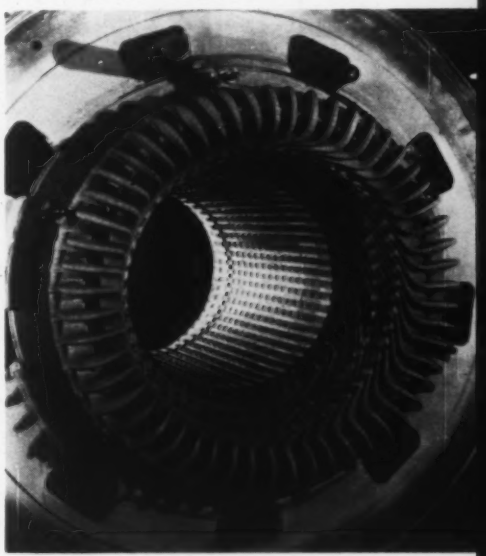
Two general types of rigid PVC are commercially available today. Type I, or normal impact, has maximum chemical resistance, while Type II, or high impact, is used where toughness is required. Both types are based on unplasticized vinyl-chloride homopolymers and are similar except that Type II has been modified to give high-impact properties. This gain in impact is made with a slight sacrifice in chemical resistance and service temperature.

In many applications normal impact compounds will perform satisfactorily with any reasonable abuse, but if extreme shock is anticipated, the high impact is better suited for the job. High-impact PVC is also widely used in profile extrusion for industrial and architectural uses because the high-impact qualities permit the use of a minimum cross section.

When designing with rigid PVC it is necessary to consider both the properties inherent in the plastic compound and the techniques of fabrication. Since rigid PVC is a new material of construction, new fabrication techniques have evolved to develop the full potential of the material.

Long-term physical properties of the material, its chemical resistance, thermal properties, fabrication techniques, and its many applications are discussed in detail in this paper.

Large motor coil insulated with silicone rubber tape (58—SA-66)



New Developments in Silicone Rubber.....58—SA-66

By G. M. Konkle, Dow Corning Corporation, Midland, Mich. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

Rubber is an indispensable material of construction. Its unique properties of extensibility and quick retraction enable it to perform many functions such as shock absorption and sealing. No other type of material could be substituted satisfactorily for these applications.

Materials are required to perform under conditions of ever-increasing severity. Quite often these conditions are particularly harmful to rubber. Such things as heat, cold, oils or fuels, and weathering can cause rapid deterioration of rubber.

Silicone rubber, owing to its unique chemical structure, has remarkable resistance to conditions which drastically affect other types of rubber. This paper reviews briefly the basic properties of silicone rubber and describes new developments.

The unusual physical properties of silicone rubber are largely due to the silicone polymers used in its manufacture. The polymer consists of long chains of alternate silicon and oxygen atoms. Heat-stable organic groups are attached to each silicon atom and give flexibility and the ability to be formed into a rubbery, elastic material.

Finely divided fillers are added to the silicone polymer to increase the strength of the finished product. A small amount of a strong organic peroxide converts the mixture of silicone polymer and filler to a rubbery solid when heated.

Silicone rubber is processed to the desired end product on conventional rubber-fabrication equipment. It can be molded, extruded, or coated on wire or cloth. The finished parts are usually further cured or tempered in an oven for up to 24 hr at 480 F to develop optimum properties. The degree of aftercure depends on the conditions under which it is to be used.

Recent developments include a solvent-resistant fluorinated silicone rubber, silicone rubber with greatly improved strength, room-temperature vulcanizing silicone rubber, self-adhering silicone-rubber tapes, and a silicone rubber with improved resistance to permanent deformation at elevated temperature.

Expandable Polystyrene—Applications and Fabrications.....58—SA-65

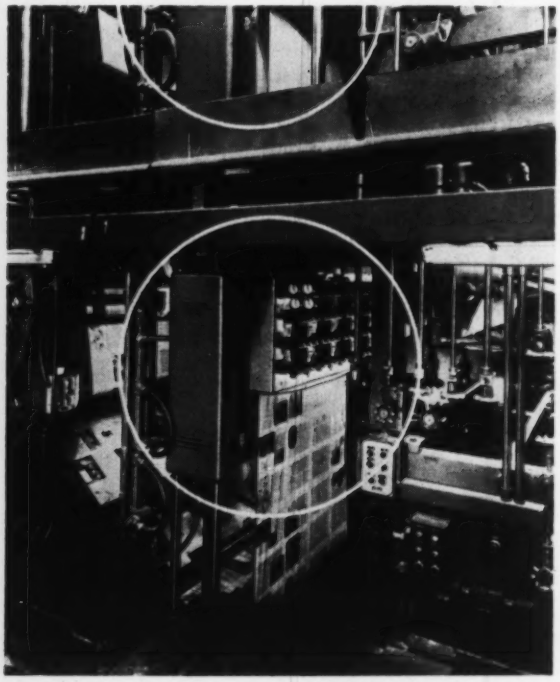
By D. F. Redman, Assoc. Mem. ASME, Dow Chemical Company, Midland, Mich. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

Expandable polystyrene is furnished in the form of small, round, free-flowing beads which vary in size from 0.7 to 1.4-mm diam. The polystyrene beads contain a dissolved gaseous expanding agent. When the beads are heated in a closed mold, the polystyrene softens and the expanding agent causes the beads to expand, producing a homogeneous foam.

This foam has a completely closed cell structure giving it excellent water resistance and thermal properties. In addition, polystyrene foam has a very high strength-to-weight ratio.

Polystyrene is one of the most widely used thermoplastics. Its most common methods of fabrication are injection molding and extrusion. When the new concept was introduced for processing polystyrene into a foam, it became possible to mold polystyrene foam into a final shape rather than fabricate it from a block of foam. In addition, it became possible to mold an article to any desired density from less than 2 lb per cu ft to over 20 lb per cu ft. This gives the engineer an almost unlimited range of properties to choose from when selecting expandable polystyrene for a molded article.

Ease of processing and exceptional properties are assets in considering expandable polystyrene for application in seven major fields: insulation, structural material, buoyancy, display (novelty and floral), packaging, electrical, and low-density filler.



Dramatic use of in-line heat processing on a modern printing press running at high speeds. Compact 2000-F heaters fit into press structure and dry inks on coated magazines. Circles show driers. (58—SA-58)

Fuels

Simplification of Gas-Fired Heat Processes.....58—SA-58

By R. C. LeMay, Mem. ASME, Selas Corporation of America, Dresher, Pa. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

In the effort to meet continued demands for increased physical properties, there has been a definite tendency for fuel-fired heat processes to become constantly larger and more complicated, to the consternation of purchaser, operator, and maintenance men. In contrast to this trend, there have been developed significant but generally isolated installations which have been advantageously simplified, with reductions in product deterioration, cost, and time.

Simplification of gas-fired heat processes through intensification of heat sources is noted. Size reduction in oven and furnaces is considered. Effective use of localized heating is described. Minimizing surface deterioration, simplified brazing, simplification by combining operations and by in-line heating are also discussed.

Aviation

Monitoring of Hydraulic Fluids During High-Temperature Testing.....58—AV-8

By R. L. Leslie, Vickers Inc., Detroit, Mich. 1958 ASME-ARS Joint Aviation Conference paper (multilithographed; available to Jan. 1, 1959).

It is well recognized that the chemical and physical nature of hydraulic fluids and lubricants changes with use. The changes that occur in fluids affect the operation of components in a hydraulic system. It is therefore necessary to follow the course of change in the fluid used in a system to understand better the performance of hydraulic components such as pumps, valves, and actuators. During high-temperature operation of hydraulic components, careful monitoring of the condition of the fluid is essential since the properties of many of the fluids change rapidly with relatively few hours of use. An important aspect of high-temperature operation which must not be overlooked is the interaction between hydraulic components and hydraulic fluid.

During the use of petroleum oils as hydraulic fluids for many years, industry has built up a backlog of experience in the reactions that take place. While there is still much to be learned about the reactions of the more familiar petroleum oils at relatively low temperatures, we have been plunged into the problem of using many different types of hydraulic fluids at much higher temperatures.

Data are presented to illustrate changes that occur to several hydraulic fluids when they are pumped at temperatures of 400 to 550 F.

Nuclear Engineering

The Operation of Centrifugal Pumps in a Pressurized-Water Reactor Plant.....58—SA-74

By L. F. Emerson, Westinghouse Electric Corporation, Pittsburgh, Pa. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

In the understanding of any operation, it is first necessary to establish a few principles pertaining to it and then amplify these to form an over-all practical philosophy. This paper provides theoretical data to support the important points for satisfactory operation of the integrated motor-driven centrifugal main coolant pump in a pressurized-water reactor plant.

These facts having been established, three basic phases of operation are analyzed: (*a*) the acceleration period, (*b*) steady-state operation, and (*c*) the deceleration period.

Finally, the actual plant conditions are imposed on the motor pump units operating in parallel.

Maintenance and Plant Engineering

Training Maintenance and Engineering Personnel.....58—SA-69

By R. G. Smith, The Dow Chemical Company, Midland, Mich. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

Training of maintenance and engineering personnel is a marvelous tool to help increase the efficiency of operations. Often a company is much wiser to accelerate its training efforts rather than curtail them when it is faced with a necessity to cut costs.

It is necessary to take a long-range view of training maintenance and engineering personnel. With the expected population increase, production demands will be greater. If an employer is to keep up with these demands, it will be necessary to step up on-the-job training, apprenticeship, and efforts to fit the right worker into the right job.

A supervisory development program for maintenance engineers and foremen is described. The basic considerations of a training program are listed, procedures for selection of trainees noted, and suggestions for selection of instructors given.

A Modern Safeguard for Automatic Boilers.....58—SA-50

By P. E. Buday, Cleaver-Brooks Company, Milwaukee, Wis. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

Until 10 or 15 yr ago most boilers were started and sequenced manually. The basic flame-failure control was a stack switch—a bimetallic device designed to sense changes in stack temperatures. Flame presence was proved by a rise in stack temperature. If flame was extinguished the control reacted to the drop in stack temperature.

Because stack temperatures do not increase or decrease rapidly, this control is slow to react to any malfunctions of firing. The trial-for-ignition period (defined as that period of time that the combustion safeguard permits the main burner fuel valve to be open before the main flame-sensing device is required to detect the main flame) of the stack switch was usually 90 sec and, in many cases, more. During this time fuel was allowed to enter the firing chamber whether flame was established or not. On flame failure, the fuel valve remained open for anywhere between 30 and 90 sec before a drop in stack temperature caused the stack switch to effect a shutdown.

Stack switches were applied only to oil-fired units.

Because combustion can be a hazardous process, boiler controls had to be designed to anticipate and forestall all conditions affecting operation from start to final shutdown. The evolution of a suitable flame-failure control has taken many years. During this time, industrial manufacturers have had to use the controls available. Although these controls, in general, are not considered satisfactory today, they all have played very important parts in the development of today's modern controls.

Commercial electronic controls and industrial electronic controls are discussed in some detail.

Computer Reduces Man-Hours in Fuel Analysis Calculations.....58—SA-62

By C. J. Wegert and W. H. Guppy, Mem. ASME, Commonwealth Edison Company, Chicago, Ill. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

Operating experience has definitely shown that the use of the digital computer can be extended to simple arithmetic calculations profitably, if the simple calculation is repetitious. Careful cost analysis should be made before switching from hand to computer calculation as computer programming and time are expensive. After the decision to change to computer calculation is made, many weeks of sometimes very frustrating program development are required.

In the case of the fuel-consumption and fuel-analysis reports, however, the savings were large enough to overcome the development costs and return a substantial profit in money and to free engineering talent for more stimulating problems.

Burner Maintenance....58—SA-56

By R. D. Reed, Mem. ASME, John Zink Company, Tulsa, Okla. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

Maintenance of equipment for any service must be done well and efficiently if the expenditure of maintenance dollars

is to be justified in either a sustained or an increased profit margin. Because progressively improved burner design now provides burners which continue to deliver their appointed heat release day in and day out, it is too often the practice where burners are used to neglect their maintenance in favor of more pressing matters. The need for maintenance is largely governed by the design of the burner and the delicacy of adjustment which may be required in order to produce heat in a manner suited to the structure being fired and the service the heat is to perform. This paper deals with burners for gaseous and liquid fuels since their characteristics vary so widely from such devices for solid fuels.

Machine Design

The Pin.....58—SA-23

By M. J. Schilhansl, Brown University, Providence, R. I. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

A pin is a machine element which secures the position of two or more parts of a machine relative to each other. A large variety of types has been known for a long time; the most commonly used are solid cylindrical pins, solid tapered pins, groove pins, tubular slotted pins, and spirally wrapped pins. The choice of size and type of a pin for a given application must be based on a sound balance of stress and strain of the pin and of stress and strain of the parts to be joined. Stress and strain of both depend upon the magnitude of the interference fit between pin and hole and upon the forces to be transmitted from one part through the pin to the other part. These forces can be constant, intermittent, or fluctuating.

An attempt is made to analyze strain and stress of different types of pins in more detail than the conventional consideration of the shear strength offers. The analysis reveals that there are cases in which the shear strength is not the criterion for the proper selection of size and type of pin. It depends upon the mutual interaction of the pin and the parts to be joined due to the fit as well as due to the lateral load which can be purely statical or dynamical. The theoretical analysis—even if it consisted sometimes of rough approximations—of the effects of fit and of lateral load and the trend of experimental results show very clearly that a spirally wrapped pin can be selected instead of any other type of pin of the same size. It offers advantages when static loads as well as fluctuating loads are involved.

Electromagnetic Multidisk Clutches .....58—SA-61

By C. Nitsche, McCauley Industrial Corporation, Dayton, Ohio. 1958 ASME Semi-Annual Meeting paper (multilithographed; available to April 1, 1959).

The electromagnetic multidisk clutch is one in which the flux does not pass the disk stack. It is obvious that in this case the disk stack can be designed and formed without regard to the magnetic circuit requirements. It is also possible to pair disks of various friction materials suitable for working dry or in oil.

The magnet body carries the inner disks which are geared to it by means of suitable spline. The outer member is linked with the outer disks by projecting bars engaged with radial slots located on the outer periphery of said disk. Upon energizing of the coil the magnetic flux passes through the working air gap and the armature, omitting altogether the disk stack. The latter can be in addition magnetically screened, if necessary. The adjusting locknut located on the outer periphery of the armature then presses the disk stack together. The working air-gap length and thus the force of attraction, acting upon the armature after the coil is energized, can be varied by means of this locknut. The armature has an axial movement on a bronze bushing and, when the coil is de-energized, a set of spring-loaded release plungers presses the armature away from the disk stack. One coil end is usually connected to a slip ring and the other to the coil member.

Advantages, installation details, and performance of an electromagnetic multidisk clutch are described. Results of experiments carried out on different types of outer and inner disks, and their influence upon the torque characteristic and release times are given. The main advantage of a multidisk clutch is its small package dimensions in relation to the magnitude of the transmitted torque. The clutch being an element suitable for remote control has been adopted readily by the gearbox designer, enabling him to dispose of a number of mechanical speed or direction changing features. Basically, two types of electromagnetically operated clutches are known: (*a*) in which the magnetic flux passes through the disk stack; (*b*) in which the disk stack is not in the path of the magnetic flux.

Design of Helical Springs for Minimum Weight, Volume, and Length. .....58—SA-9

By R. T. Hinkle, Mem. ASME, and I. E. Morse, Jr., Michigan State University, East Lansing, Mich. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

In the design of helical springs where the load, deflection, allowable stress, and material are specified, there are an infinite number of solutions. In this paper, equations and graphs are presented for the selection of a spring index that will result in a spring of minimum weight, volume, or length. If, in addition to these requirements, the inside or outside diameter of the spring is fixed, there is only one solution. Equations and graphs are included for the selection of the spring index which will satisfy this additional requirement.

Helical Springs of Hollow Circular Cross Section.....58—SA-18

By C. W. Bert, Assoc. Mem. ASME, Battelle Memorial Institute, Columbus, Ohio. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

A theoretical and experimental investigation of elastic shear stresses and deflection in an axially loaded helical spring having a hollow circular cross section is reported in this paper. Two analyses are presented: An approximation of the stresses by strength-of-materials theory, and a more accurate elasticity-theory solution for stresses and deflection. The results are compared with strain and deflection measurements on an actual tubular spring.

Stress and Strain in Spinning Paraboloid Dishes.....58—SA-8

By M. J. Cohen, Northampton College of Advanced Technology, London, England. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

The paper relates an investigation to determine completely the state of stress and strain in spinning paraboloid dishes both whole and holed at the center. The material of the dish is homogeneous and its thickness is constant. The results comprise expressions for the radial, hoop, and shear stresses, the bending moments, and deformations induced by the spinning of the dish in terms of the angular distance from the center of the dish. Tables at the end of the paper make the actual evaluation of these stresses, moments, and deformations a matter of simple arithmetic.

Production Engineering

A System for Computer Control of Production and Inventory..... .....58—PROD-5

By J. E. Haynes, International Business Machines, New York, N. Y. 1958 ASME Production Engineering Conference paper (multilithographed; available to Feb. 1, 1959).

Inventory and production controls are among the major problems facing industry today. Certain applications of data-processing equipment to these areas have been successful.

An integrated data-processing system to control production and inventory is described in this paper. The development of the system is traced from market-sales forecasting to control reports on the finished product. A computer is used to implement the operation and analyze all statistical data. The order-point concept is employed as well as a component-parts-requirement program. The entire discussion is an analysis of the application of the system at two plants within International Business Machines.

Controlled Contact Cutting Tools.. .....58—SA-42

By B. T. Chao and K. G. Trigger, Mem. ASME, University of Illinois, Urbana, Ill. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

A substantial reduction in power consumption, an increase in tool life, more effective utilization of cutting fluids, and improved surface finish on the machined workpiece have been achieved by suitably controlling the length of tool-chip contact. Reasons for these findings are discussed in terms of basic variables in chip formation mechanics.

Artificially restricted contact tools open new avenues for metal cutting research. Machining data obtained with such tools provide further evidence of the invariant behavior of the dynamic shear stress of metals under high-speed cutting conditions, and unfold interesting information on the intricate nature of tool-chip contact.

The Effect of a Lead Additive on the Machinability of Alloy Steels..... .....58—SA-53

By Norman Zlatin, Mem. ASME, and J. V. Gould, Assoc. Mem. ASME, Metcut Research Associates, Inc., Cincinnati, Ohio. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

For many years free-machining additives such as sulfur, selenium, or lead have been used in low-carbon steels to improve tool life and surface finish. During the past ten years free-machining additives have also been used in the medium-carbon alloy steels. However, the principal use of these free-machining grades of alloy steels has been at hardness levels under 300 Bhn. With the trend toward higher strength steels (400 Bhn and higher), the machining problems have become more difficult. Considerable thought has been given to the use of a lead additive as a means of alleviating the machining problems at the higher hardnesses.

The data presented in this paper are the results of turning tests, using carbide tools, on two medium-carbon steels at several different hardness levels. Data demonstrate that:

1 The use of a lead additive in medium-carbon alloy steels will result in appreciable increases in tool life for those steels having a hardness of R_c30 or less. The advantage of the lead additive will decrease as the hardness of the steel increases beyond R_c30. At some point in the hardness range of R_c35 to R_c40 or higher, the presence of the lead additive may be detrimental to tool life.

2 Appreciable improvement in surface finish is obtainable on medium-carbon alloy steels, regardless of the hardness of the steel.

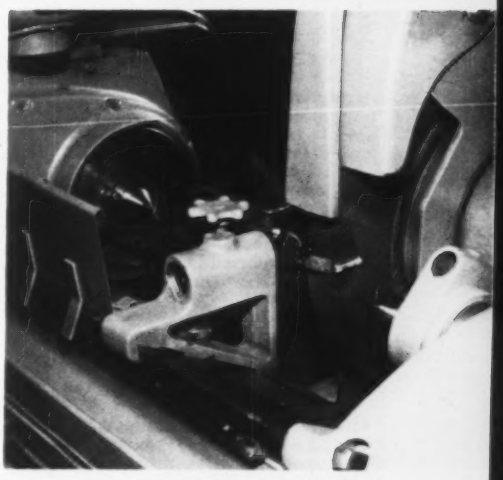
3 The addition of lead to medium-carbon steels at various hardness levels will result in a reduction of 15 to 25 per cent in power required in machining.

Factors Influencing the Performance of Grinding Wheels.....58—SA-40

By E. J. Krabacher, Assoc. Mem. ASME, Cincinnati Milling Machine Company, Cincinnati, Ohio. 1958 ASME Semi-Annual Meeting paper (in type; to be published in *Trans. ASME;* available to April 1, 1959).

Optimum utilization of grinding wheels can best be achieved if the nature of their performance and wear characteristics, and the factors that affect these characteristics, are understood and applied. As reported in this paper, a comprehensive, continuing, grinding-research program has contributed to such an understanding.

A study of the nature of grinding-wheel wear indicates that the grinding-wheel wear curve is similar to those of other cutting tools. It demonstrates further that the type of grinding operation significantly affects the nature of wheel wear. A unique technique has been developed for very accurately measuring grinding-wheel wear. This measured wear may be translated into terms of "grinding ratio," which is the generally accepted parameter for measuring wheel wear. It



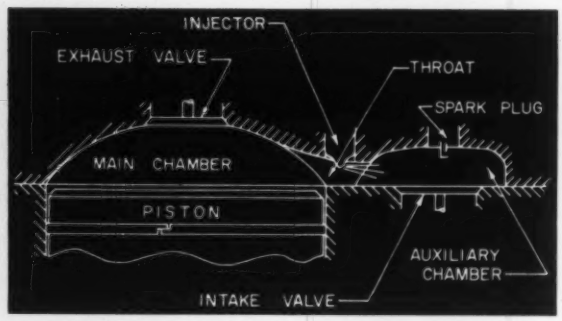
Electric strain-gage transducer for measuring grinding wheel (58—SA-40)

is the ratio of the volume of metal removed per unit volume of wheel wear.

Extensive studies have been carried out to determine the effect of mechanical variables on grinding ratio, power required in metal removal, and on surface finish. Experimental findings indicate that grinding ratio decreases with increased metal-removal rate and increases with workpiece diameter, decreased chip load, and increased concentration of grinding fluid. Power is found to increase with both the metal-removal rate and the amount of metal removed. It increases slightly with workpiece diameter and is affected little by work-material hardness. Surface finish is found to improve with decreased metal-removal rate and decreased chip load. It also is affected little by work diameter or work-material hardness.

Fundamental research in the mechanics of wheel wear is supplying much additional information in the study of grinding-wheel wear. The measurement of grinding forces employing a cylindrical grinding dynamometer provides the opportunity for relating the wear of grinding wheels to the basic mechanics of the process through such fundamental quantities as grinding forces, specific energy, and grinding friction.

Two additional experimental techniques for the study of chip formation in grinding have also proved to be most useful research tools. A "quick-stop" apparatus is used to freeze the grinding action by accelerating a tiny workpiece almost instantaneously to grinding-wheel speed. Another technique permits the comparison of the shape of the grinding grit and that of the contour of its path through the workpiece by a unique replicating method.



Combustion chamber of experimental engine is divided into a main chamber and an auxiliary chamber. The two are interconnected by a throat. (58—OGP-5)

Oil and Gas Power

Scientific Design of a Diesel Governor.....58—OGP-11

By A. G. Massey, Mem. ASME, Curtiss-Wright Corporation, Watertown, N. Y.; and R. Oldenburger, Mem. ASME, Purdue University, Lafayette, Ind., and Curtiss-Wright Corporation, Cleveland, Ohio. 1958 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1959).

Factors which must be considered in the scientific design of a diesel governor are covered. Specifications as to size, output work, oil-supply pressure, and such, are outlined. The paper treats simplifying assumptions that may be made in setting up the differential equations of the governor, the engine, and load. The solution for a diesel governor is given with curves of its dynamic performance on a given diesel, and its open-loop frequency response for different governor adjustments. Several principles given here apply to all dashpot-type governors.

The Free-Piston-Engine Possibilities.....58—OGP-7

By A. F. Moiroux, SEME-SIGMA, Paris France. 1958 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1959).

In a discussion of the possibilities for the free-piston engine this paper: Describes briefly the operation of that engine, particularly the Model GS 34; explains the basic principles and the characteristics of the cycle under the simplest form and shows the evolution of the performance as well as the problems encountered; and describes the free-piston diesel-engine component.

Although the appearance and the construction are quite simple, the free-piston gasifier has a rather complicated operation because there is no mechanical connection between pistons and power-shaft. However, in spite of that, the control of the piston motion is safe and precise.

The very great amount of experience in the conventional diesel-engine development is of great interest but cannot be strictly applied to a free-piston engine because the diesel engine is only one component of the machine, and it is necessary to develop a "free-piston way of thinking."

The success of this engine could lead to two important conversions: In the engine industry where no machining problem is involved and which would benefit by utilization of this new development; and in the oil industry where the use of low refined fuel would allow a great simplification and a more rational use of our natural wealth.

A Method of Charge Stratification for Four-Stroke-Cycle Spark-Ignition Engines.....58—OGP-5

By L. D. Conta, Mem. ASME, and P. Durbetaki, Assoc. Mem. ASME, The University of Rochester, Rochester, N. Y. 1958 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1959).

During the past decade the passenger-car engine has been characterized by a continuous increase in horsepower capacity. In spite of many design improvements and a steady increase in compression ratio, this increased output has necessitated a very substantial increase in engine size and displacement. As a result of this development the modern passenger-car engine spends practically its entire life operating under very light load conditions and hence with relatively poor fuel economy. Although the problem of attaining good part-load economy has thus become of greater and greater importance, no real progress toward its solution has been made.

One method of improving the efficiency of the spark-ignition engine at light load is the use of mixture-ratio control to effect load variations. Charge stratification makes this method of load-control possible. In this paper the principles involved in stratification are discussed, and a new method for producing stratification is described. The results of engine tests using this method are presented to show the method is workable, and that the predicted advantages actually are obtained.

The Buchi-Telescope-Valve System on Four-Cycle Diesel Engines.....58—OGP-10

By A. J. Buchi, Mem. ASME, Winterthur, Switzerland. 1958 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1959).

The telescope-valve engine is an improved four-stroke-cycle internal-combustion engine. It is especially built with or without pressure charging, preferably combined with scavenging, to sweep out the exhaust gases from and to cool the combustion space. A swirl is generated in this space for a simple and perfect fuel distribution and combustion.

Such an engine design may be adopted for internal-combustion engines of any size and use, and of any cylinder arrangement, as in-line, V, boxer, twin-bank, radial, vertical, or horizontal types. The telescope-valve system and its special design of the cylinder head, combustion chambers, valves, fuel-injection-system, and valve control-mechanism are also favorable for other than diesel engines, such as gas, gasoline, or heavy-fuel engines. For any special fuel, of course, the proper fuel-atomizing system has to be adopted.

Combustion and fuel injection, the telescope inlet, and exhaust valve arrangement with control gear are treated in detail. Advantages of this type engine as compared with conventional engines are also outlined.

The Filtration of Diesel Engine Oils.....58—OGP-4

By J. R. McCoy, Indiana Commercial Filters Corporation, Lebanon, Ind. 1958 ASME Oil and Gas Power Conference paper (multilithographed; available to March 1, 1959).

Lubricating oil systems for diesel engines vary considerably because of the variation in the size and speed of each engine.

Engines may be of the wet-sump type which utilize the base of the engine or crankcase as the oil reservoir or they may be of a dry-sump type which utilizes a separate tank as the reservoir. High-speed engines are generally of the wet-sump type while low-speed engines may be either. If the dry-sump principle is used, a scavenger pump is quite frequently provided to pump the oil from the base of the engine to the outside reservoir. This scavenger pump usually is capable of pumping more oil than is available, con-

sequently, it will pump a considerable quantity of air along with the oil.

It is the purpose of this paper to discuss briefly engine construction as related to oil filtration, oil contamination and deterioration, the selection and installation of filters, and the benefits derived. This discussion is slanted toward large engines of the stationary and marine types and applies to full diesels as well as dual-fuel and gas-burning engines.

Filtration of the lubricating oil of an engine is very important from an engine maintenance standpoint. The severity of the engine operation, the type of oil, and the type of fuel used influence the type and size of filter that should be used and its method of installation.

Filters may use many types of media, both inert and adsorbent. Each type has a very definite place. Proper oil filtration can cut engine wear to a fraction of what it would be without filters.

THE JULY, 1958, issue of the *Transactions of the ASME* (available at $1 per copy to ASME members; $1.50 to nonmembers), contains the following:

Technical Papers

Problems in Measuring Steam Flow at 1250 Psia and 950 F With Nozzles and Orifices, by J. W. Murdock and J. Goldsbury. (57—A-88)

The Dependence of Thermal Stresses in Cylindrical Reactor Fuel Elements Upon the Method of Cooling, by K. R. Merckx. (57—A-136)

Vibration of Rods Induced by Water in Parallel Flow, by D. Burgreen, J. J. Byrnes, and D. M. Benforado. (57—A-94)

Apparatus for the Experimental Study of the Thermodynamic Properties of Water, by H. H. Reamer, G. N. Richter, W. M. DeWitt, and B. H. Sage. (57—A-266)

An Instrument for the Measurement of the Viscosity of Steam and Compressed Water, by J. Kestin and J. R. Moszynski. (57—A-237)

Economic Choice of Generator Unit Size, by L. K. Kirchmayer and A. G. Mellor. (57—A-154)

Ideal Performance of Valved-Combustors and Applicability to Several Engine Types, by A. W. Goldstein, J. F. Klapproth, and M. J. Hartmann. (57—A-102)

Advancing Adhesion—Development and Test of a Chemical Formulation to Condition the Running Surface of Rail for Improved Wheel-to-Rail Adhesion, by F. G. Fisher, R. K. Allen, and G. W. Luvisi. (57—A-130)

A Method for Studying the Behavior of Cutting Fluids in Wear of Tool Materials, by L. V. Colwell. (57—A-160)

The Spiral Point Drill—A New Concept in Drill Point Geometry, by Hans Ernst and W. A. Haggerty. (57—A-98)

Behavior of Cutting Fluids in Reaming Steels, by L. V. Colwell and Henrik Branders. (57—A-168)

The Chatter of Lathe Tools Under Orthogonal Cutting Conditions, by S. A. Tobias and W. Fishwick. (57—SA-19)

The Effect of Tool-Chip Contact Area in Metal Machining, by H. Takeyama and E. Usui. (57—A-45)

The Pressure-Viscosity Effect: Background, by H. A. Hartung. (57—A-277)

Viscosity-Pressure Effect on Friction and Temperature in a Journal Bearing, by S. J. Needs. (57—A-66)

Experiments on Imperfect Lubrication, by M. D. Hersey and C. W. Staples. (57—A-62)

Influence of Pressure and Temperature on Oil Viscosity in Thrust Bearings, by B. Sternlicht. (57—A-275)

Some Factors Influencing the Area-Load Characteristics for Semismooth Contiguous Surfaces Under "Static" Loading, by F. F. Ling. (57—A-246)

Transition From Laminar to Turbulent Shear Flow—A Review of Some Recent Advances in Its Understanding, by M. V. Morkovin

Flow Characteristics of a Multiple-Cell Pump Basin, by W. L. Dornaus. (57—A-59)

Prediction of Flashing Water Flow Through Fine Annular Clearances, by A. Agostinelli and V. Salemann. (57—A-78)

Symposium on Welded Spiral Cases From the Consulting Engineers' and Users' Viewpoint (57—A-106):

Hydraulic and Weight Features of Welded Spiral Cases, by R. A. Sutherland

Welded Spiral Case Construction Procedures, by G. R. Latham

TVA Experiences, Welded Versus Riveted Spiral Cases, by R. M. Gardner

Pressure-Embedment of Spiral Cases, by B. G. Seitz

Blowdown and Charging Processes in a Single Gas Receiver With Heat Transfer, by W. C. Reynolds and W. M. Kays. (57—A-137)

The Transient Response of a Two-Fluid Counterflow Heat Exchanger—The Gas-Turbine Regenerator, by R. M. Cima and A. L. London. (57—A-135)

Discussion on Similar Solutions for Free Convection From a Nonisothermal Vertical Plate, by E. M. Sparrow and J. L. Gregg

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Includes Letters from Readers on Miscellaneous Subjects

COMMENTS ON PAPERS

Adventure in Science

To the Editor:

I ENJOYED Professor Keenan's article, "Adventure in Science," in the May, 1958, issue of MECHANICAL ENGINEERING, pp. 79–83.

There are other fields in mechanical engineering; e.g., fluid mechanics, mechanics, and so on, which would provide interesting historical material. The histories of some of the products of mechanical engineering; e.g., boilers, steam turbines, and the like, would also provide interesting reading to remind us of our heritage. Such articles also help to stimulate the enthusiasm and interest of our student members who often find the more technical articles beyond them.

Clifford L. Sayre, Jr.[1]

Safe Use of Isotopes in Industry

Comment by W. A. McAdams[2]

The author of this paper[3] has presented an informative and concise summary of some of the more practical industrial applications of radioisotopes and has given about the right emphasis to the hazards involved in their use. I agree with most of his concepts for a radiation-protection program, but disagree with his assignment of responsibility for certain parts of the program.

I feel strongly that the manager or supervisor in charge of a particular operation should be completely responsible for its safety. He should select his personnel, see that they are properly trained, establish and enforce operating and safety procedures, provide for necessary control tests, maintain suitable records, and provide proper equipment and safety devices.

When radiation hazards are involved in the work he should take this into account in carrying out his normal managerial responsibilities. In doing this he may obtain the help and advice of the radiation-safety supervisor, but he must still make the decisions for all matters which pertain to the conduct of the work for which he is responsible. Even the monitoring, or at least most of it, should be performed by personnel reporting to the operating supervisor and not by personnel assigned to the radiation-safety supervisor. If the work is carried out in this manner, the radiation-safety supervisor will be able to take his proper place in the organization as a technical adviser rather than as a policeman or routine monitor.

[1] Assistant professor of mechanical engineering, University of Maryland, College Park, Md. Assoc. Mem. ASME.

[2] Consultant, Radiation Protection, General Electric Company, Schenectady, N. Y.

[3] W. A. Brobst, "The Safe Use of Isotopes in Industry," MECHANICAL ENGINEERING, vol. 80, March, 1958, pp. 69–70.

Straightening Vanes for Flow Measurement

Comment by R. B. Dowdell[4]

It is pleasing to see additional investigations being made on the performance of straightening vanes. Frequently, the importance of these devices is overlooked and the primary element gets all the attention in flow metering installations. A manufacturer can give the utmost care to the primary element, but he cannot alter it to correct for unknown flow disturbances.

The multiplate device described in this paper[5] appears to be more effective for straightening the flow than any of the other devices described. However, it seems to obtain this effectiveness at the expense of additional pressure loss. The authors seem to minimize the importance of maintaining a low-pressure loss, but it is my experience that the loss through vanes are often as important as the loss through the differential producer itself.

Perhaps a more desirable parameter for the comparison of straightening vanes would be the ratio of straightening-vane effectiveness to the pressure-loss coefficient, the straightening-vane effectiveness being similar to that described in this paper, i.e., the amount of error remaining on a given differential producer after straightening the flow from a given disturbance.

A second important parameter would be the number of pipe diameters required from the inlet of the straightening device to the primary. This could be expressed as a ratio of effectiveness to diameters.

A third important criteria in choosing straightening vanes is that of their cost. Clearly, the simple cross-plate straightening vane having four to six plates should be less expensive to manufacture than the multiplate straightening vane as described in this paper.

There is no doubt, however, that the authors have added some valuable information to the fluid-metering profession and are to be commended on their work.

Comment by J. E. Downs[6]

The importance of accuracy of flow measurements in acceptance tests and performance monitoring of large modern steam turbines is indicated by the large value assigned to the efficiency of these units. It is common these days for $^1/_4$ per cent difference in heat rate to be considered worth tens of thousands of dollars capitalized. This amount provides an index of the large worth of the contribution of the authors of this paper[5] in developing a new straightening vane which greatly minimizes the effect of up-

[4] Fluid mechanics engineer, Builders-Providence, Inc., Division, B-I-F Industries, Providence, R. I. Mem. ASME.

[5] R. E. Sprenkle and N. S. Courtright, "Straightening Vanes for Flow Measurement," MECHANICAL ENGINEERING, February, 1958, vol. 80, pp. 71–73.

[6] Engineer, large steam turbine-generator department, General Electric Company, Schenectady, N. Y. Mem. ASME.

stream disturbances on the flow coefficient of the primary element. It also serves as a reminder that differences in upstream conditions can cause differences in flow coefficient between calibration and use of a flow measuring section unless an adequate flow straightener is used.

The use of six elbows plus the flow disturber upstream certainly provided a severe test of a flow straightener and the test results show the multiplate type as being much more powerful in eliminating these effects than the other types tested. The General Electric Company's Large Steam Turbine-Generator Department, which tests a number of turbines each year, has been using flow sections incorporating the multitube-type straightener, 18 pipe diameters between the straightener and primary element, and a flow nozzle for the primary element with β ratio less than 0.5. Although we have no indication of significant errors under the more favorable conditions of greater distance downstream from the straightener, smaller β ratio and with the use of flow nozzles instead of orifices, we are considering the use of the new multiplate flow straightener in the future.

Comment by L. K. Spink[7]

It is obvious that an abnormal axial-velocity profile will create an error in measurement. This is shown mathematically in Prof. W. S. Pardoe's paper "The Effect of Installation on the Coefficients of Venturi Meters," *Transactions of the ASME*, 1936, vol. 58, p. 678. However, there is no proof that an axial-velocity traverse is a criterion for the more serious errors in orifice measurement. The evidence points more strongly to the influence of circumferential velocities which would obviously affect the angle at which the fluid passed the orifice edge and hence affect the size of the jet. Weight is added to this theory by the fact that the effects of vortex-type disturbances were less on the venturi with its confined jet, and, in general, were in an opposite direction from the effect on the orifice.

The erratic results obtained with the multiple-tube-type vane are so contrary to those obtained on any of the AGA-ASME tests at Buffalo, N. Y., that the question arises as to whether the tubes were symmetrically arranged and installed parallel to the conduit. Also, the usual tubular-type vane for 4-in. pipe contains about 11 tubes and is installed about eight-pipe diameters from the outlet of the multiple elbow outlet. Installation of a 41-tube vane at two-pipe diameters from the outlet would be expected to perpetuate more of the abnormal axial velocity pattern.

However, the entire industry is looking for a flow straightener which will permit accurate measurement in a shorter space. These tests indicate that the multiple-plate type has distinct possibilities in this respect. The high-pressure drop (especially if compared to a vane with a normal number of tubes) would be a distinct deterrent to its use in many cases. Other experimenters have shown that the high-pressure drop is essential to efficient straightening action. With the high restriction, there is an increased tendency toward plugging which would be a factor on many installations.

The multiple-plate straightener could be installed with much less chance of disintegration than the conventional vane, and this should appeal to those measuring high velocity steam to turbines and similar services.

Comment by S. R. Beitler[8]

One of the normally unmeasured imponderables, in connection with the use of orifices, venturis, and nozzles as accurate flow-measurement devices, has been the effect of inlet piping on the flow through the primary element.

The general method of specifying the flow condition ahead of the primary element has been to give a certain number of required diameters of straight pipe, to attempt to specify the inside surface of this pipe, and to assume that, if certain specifications are met, the velocity profile ahead of the primary element will be near enough to the profile used in calibration of the element to reproduce the calibration conditions. Therefore the coefficient used in the calibration can be used with the primary element as actually installed without any correction factor. It is well known that any serious upstream disturbance, which would create non-normal velocity profiles in the pipe ahead of the primary element, will cause inaccurate pressure differential readings at certain rates of flow. Because of the knowledge of these facts, the ISO TC/30 Working Group 3, on primary element installation, has requested that any work done in connection with this type of approach flows be supplemented by velocity traverses ahead of the primary element. As far as I know, this paper presents the first work in this country in which this measurement has been attempted. The results are interesting; however, they do not yet show the velocity profile ahead of the orifice since the only thing measured was the axial speed of the water so that an axial velocity profile was determined. No attempt was made and no equipment was available for determining the nonaxial velocities and eddies which might also have considerable effect.

The writer has had access to the original data for both the four-in. and the ten-in. pipes and has attempted to make some study of the approach of the velocity profile. The results have, in the opinion of the writer, been interesting and indicate that there are a lot of things which we do not know about flow through an orifice or other primary devices. Since this work has been done on orifices, no other types of devices will be discussed at this time. However, it is felt that the results with orifices would also apply possibly to a lesser amount to both nozzles and venturis. In order to set up some simple parameter for the study of this flow condition, based on actual velocity, the writer has used the actual velocity plots (which incidentally are somewhat more irregular than indicated in the paper)[5] and the five-equal-area method to compute the average velocity and the velocities in the five areas and to get a comparison between the assumed kinetic energy in the flowing fluid ahead of the orifice and the actual kinetic energy and also to attempt to get a simple indication of the approach conditions. The parameter chosen was the ratio of the velocity in the inner fifth of the pipe divided by the velocity in the area next to the outer one. The parameter was chosen because it was simple to use and contained no extrapolations. In the first attempt, which was made to get a comparison, the parameter used was the velocity in the inner 40 per cent divided by the outer 40 per cent, but this required some extrapolation in the curves and was discarded though it would probably be a better indication of flow conditions.

Table 1 gives the values of this parameter for five different conditions in each of the pipelines. It will be noted in both cases that the velocity in the outer ring was higher than that of the center and that the measurements were inaccurate. It will also be noted that in both cases the velocity in the center was more than 1.9 times the velocity in the outside and that the measurements were inaccurate. In the other six conditions, where the ratio of velocities ran from 1.119 to 1.535, the measurements were satisfactory with the exception of one case. This was the case in the four-in. line where the multicross straightening vanes were used and where the ratio was 1.356, but the measurements were not satis-

[7] Engineer, in charge of flow measurement, The Foxboro Company, Foxboro, Mass. Mem. ASME. (Deceased Dec. 24, 1957.)

[8] Professor of mechanical engineering, Ohio State University, Columbus, Ohio. Fellow ASME.

Table I—Comparison of Velocities in Approach Piping

Condition	Velocity in center 1/5 of area	Velocity in ring no. 4 1/5 area	Ratio	Measurement condition
	4-in. pipe			
Straight pipe	16.00	13.96	1.146	Good
With disturbers and multiplate vanes	15.56	13.90	1.119	Good
With disturber, no vanes	13.68	14.27	0.959	Bad
With disturber and multicross vanes	17.28	12.76	1.356	Bad
With disturber and multitube vanes	13.68	13.85	0.988	Bad
	10-in. pipe			
Straight pipe, no vanes	12.88	8.54	1.510	Good
Disturbers and multiplate vanes	11.73	8.97	1.306	Good
Disturbers and multiplate vanes	18.69	12.18	1.535	Good
Disturber, no vanes	12.62	6.22	2.027	Bad
Disturber, no vanes	20.55	10.70	1.922	Bad

factory. It is difficult to explain this particular phenomenon since the traverse was not too bad and yet the readings on the primary element were inaccurate. As far as the traverses are concerned then, these tests do not indicate any conclusive results and probably a good deal of additional work should be done on the effect of velocity traverses on the flow-through primary element. It is hoped that these kinds of data can be taken in all tests in the future.

As far as the proposed plate-type vanes are concerned, it is the writer's opinion that they represent a large advance in the process of straightening out flows. It has always been his opinion that the older design of tubes or multicross vanes might, under certain conditions, aggravate the bad flow conditions instead of improving them and that fundamentally all they took out was the nonaxial components of flow which, however, may be of major importance in many cases.

However, if there was a bad velocity profile, it might accentuate this irregularity rather than eliminate it.

It is the writer's belief that the plate-type straightening vanes could be designed to give much lower pressure losses than the ones reported on here at a slight increase in cost in the manufacture of the vanes. This could be done by making the passage in the shape of a venturi with a restoration cone on the outlet rather than a straight cylindrical section. Without doubt, the large energy loss comes in the energy dissipated by discharging the stream into the section at the ends of the plate and is caused by the loss due to sudden enlargement. The plate could be designed with a gradual enlargement rather than a sudden enlargement. Then considerable loss would be eliminated and the operating cost of these might be reduced to the point where the pressure loss would be competitive of that of other type vanes. The paper certainly indicates great possibilities for this type of straightening devices.

Authors' Closure

The authors are most appreciative of the written comments submitted by the four discussers, the general tenor of which indicates approval of the multiplate-type of flow straightener. It is particularly pleasing to learn from J. E. Downs' discussion that the GE Large Steam Turbine Generator Department, Schenectady Works, is seriously considering using this straightener in future turbine acceptance tests.

Objections to the comparatively large pressure loss were voiced by both Mr. Dowdell and Professor Beitler, the latter suggesting that the shape of the outlet of the holes in each plate be formed in a manner similar to the restoring cone of a venturi tube. This sounds like an excellent suggestion, for which the authors duly express their thanks. As soon as our laboratory-test schedule permits, we intend to investigate this change in hole shape, and/or any other changes that might lead to a reduction in the over-all pressure loss. The authors feel, however, that a certain minimum pressure drop must occur across the straightener in order to measure flow accurately, especially within the accuracies of performance monitoring applications. Perhaps this minimum will be found during studies of the hole-shape effects.

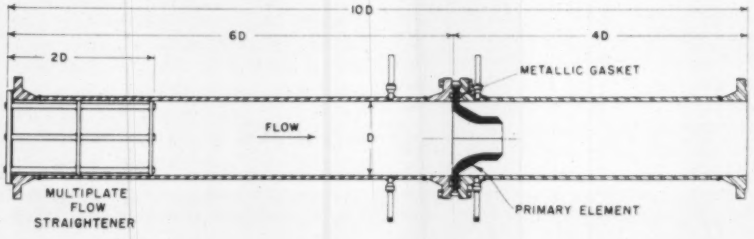
J. E. Dowdell's suggestion of using the ratio of straightening-vane effectiveness to pressure-loss coefficient is an interesting and perhaps desirable one. However, along with pressure drop, proper separation of flow streams and proper intermixing afterward are important factors. The authors found that varying only the spacing between the multiplates can seriously detract from the straightening effect, although the pressure drop remains essentially constant.

Another parameter suggested by Mr. Dowdell is the number of pipe diameters required from the inlet of the straightening device to the primary element. While our earlier tests, as reported in the paper, used ten pipe diameters between the inlet of the flow straightener and the primary element, subsequent investigation showed that this could be reduced to six pipe diameters with no loss in accuracy. The presence of a control valve located four pipe diameters beyond the primary element did not detract from the measurement accuracy even when it was throttled through a 4-to-1 flow range. A flow tube as indicated in Fig. 1 can thus be supplied, making the primary element measuring device entirely independent of its environment, both preceding and following the flow-tube section.

The authors believe the reason that the multitube straightener was satisfactory in the AGA-ASME tests at Buffalo and not in our experiments—a point questioned by Mr. Spink—was that the nature of the disturbances created in the Buffalo tests was, by no means, as severe as that produced at both the Bailey Meter Company and the Ohio State tests. The arrangement of the tubes in the Bailey Meter Company test was symmetrical, as were the holes in the plates, and the tubes were carefully paralleled with the conduit.

Professor Beitler's ingenious parameter of relating the center velocity to that of the outer ring is interesting and informative. However, with the data on hand, it is as he states, inconclusive.

Fig. 1 Flow tube can be supplied to make the primary element measuring device entirely independent of its environment. No projections such as thermometer wells, backing rings, and the like are placed inside of pipe.



The thing that is most important is the ability of the device to produce the normal coefficient of discharge regardless of the environment of the pipe adjacent to the primary element; the creation of a normal velocity profile would largely be automatic when the effects of the disturbances are eliminated completely.

R. E. Sprenkle[9] and N. S. Courtright.[10]

[9] Director of education, Bailey Meter Company, Cleveland, Ohio. Mem. ASME.
[10] Assistant director of education, Bailey Meter Company, Cleveland, Ohio.

Axial-Flow Exhaust Turbine and Monotube Boiler

Comment by J. D. Andrew, Jr.,[11]

THIS is an excellent paper[12] that deserves thorough study in order to appreciate many of the details. This refers specifically to the monotube boiler, a once-through circulation design.

Education of our engineers and operators as to the concepts of this type of boiler design is extremely important. The design in itself is not new, having over 25 years background in Europe, but it is entirely different from natural circulation as we have always known it in this country.

The once-through boiler is the immediate answer to the ever-increasing demand for higher-cycle efficiencies with an economic benefit. This paper exposes the urge to increase the nominal turbine-throttle pressure of 2400 psi up another 120 lb in order to gain five per cent capacity from an existing design of equipment. This pressure increase is reaching the point where no economic return is possible with the drum or natural-circulation-type of boiler. There is no pressure barrier with the once-through circulation.

It goes without question that we are not to end our efforts at the present 1050 F and 2400 psi. The authors and those engineers they represent are to be commended for this contribution in the direction of breaking down these barriers to higher efficiencies and more economical kilowatts.

Comment by I. J. Karassik[13]

I wish to congratulate the authors of this paper[12] for their lucid and complete presentation of the basic philosophy which underlies the conception of the Portland Generating Station. Such a presentation makes the description of the cycle selected and of the new and unusual features which will distinguish this plant from the conventional steam-generating stations that much more interesting.

Since there are to be many novel and untried applications in the Portland Generating Station, it was important to reduce to the minimum possible any concern as to the one vulnerable component—the boiler feed pump. It was this desire which led the plant designers to investigate the improved reliability factors which could be obtained by: (*a*) high-speed pumps; (*b*) the use of booster pumps; and (*c*) the elimination of packed stuffing boxes in favor of condensate injection sealing.

The major contribution of the high-speed pump is that it reduces the number of stages required to generate the total head and therefore reduces materially the shaft span between bearings. The shaft deflection of a high-speed pump is reduced to about a third of that of a conventional 3500-rpm pump. Since the internal clearances can be kept to the same order of magnitude, the margin of safety against accidental contact is increased immeasurably.

The use of the booster pumps to provide the feed pumps with sufficient NPSH (net positive suction head) has a number of beneficial effects. It permits lowering the elevation of the deaerating heater, saving considerable structural steel. The shorter suction piping reduces the residence time between the heater and the pumps, and this acts beneficially on the permissible rate at which pressure can be permitted to drop at the heater after a load rejection. Finally, with the deaerating heater located that much lower than in a conventional steam-power plant, the high-pressure, closed heaters will drain into it by gravity at all loads, without the need of heater-drain pumps. If, instead, the designers had contemplated dispensing with drain pumps and flashing the drains into the condenser at light loads, the use of booster pumps will eliminate the attendant heat losses.

As to condensate injection sealing, we are all familiar with the fact that, barring accidents during the start-up period, today's high-pressure boiler-feed pumps can operate up to 100,000 hr and more without requiring internal overhaul. But stuffing box packing does not have such a long life. At best, it becomes necessary to repack stuffing boxes every 12 to 18 months. The elimination of stuffing box packing in favor of condensate injection sealing shows all indication of eliminating as well this incompatibility between these two operating period cycles.

I am sure that we have not reached the ultimate perfection either in the design of steam-power plants or in that of boiler-feed pumps. But it is encouraging to see that so many improvements in both these fields have taken place and are continuing to do so at the present time.

[11] Application Engineer, The Babcock & Wilcox Company, New York, N. Y. Mem. ASME.
[12] J. G. Miller and R. H. Kreisinger, "Portland Generating Station," MECHANICAL ENGINEERING, February, 1958, vol. 80, pp. 64–70. Condensed from ASME Paper No. 57—PWR-3.
[13] Consulting engineer and assistant to vice-president, Harrison Division, Worthington Corporation, Harrison, N. J. Mem. ASME.

Creativity in Engineering

Comment by M. S. Gjesdahl[14]

THE present dynamic age of technology demands the maximum development of the creative potential of every scientist and engineer. The experience of the authors[15] at the University of Minnesota in enabling student mechanical engineers to meet industrial problems under the guidance of men in industry serves two desirable purposes: (1) the students are faced with nebulous problems for which there may be more than one answer; (2) the industrialist becomes a teacher and contributes to the students' acquisition of knowledge.

Since 1949, in a required applied machine-design course at Penn State, the members of the teaching staff have given the students creative projects to design. The problem has been different each year and has been some device which is not available on the market, such as, a portable gasoline-motor operated hoist, an electric-motor driven hand-tool nailer for driving 4 to 8 penny nails, a stopping device which may be attached to trailer trucks to be operated in case of failure of the brake system. It has been the practice to have an ideation or "brain-storming" session in each class for the stimulation of ideas. Later, an evaluation of the ideas permits the students to exercise judgment and then select the procedure they intend to follow. The students are encouraged to try out their ideas by sketching and by completing a layout drawing. At the end of the semester each student is given an opportunity to explain his design to a panel of three persons, one of whom is his instructor and the other two may be called in from

[14] Professor of mechanical engineering, The Pennsylvania State University, University Park, Pa. Mem. ASME.
[15] D. G. Taylor and R. C. Jordon, "Developing Creativity in Engineering," MECHANICAL ENGINEERING, February, 1958, vol. 80, p. 74.

other engineering departments. The panel serves to make an appraisal of the design and it is of interest to observe the careful presentation by the student particularly when the design has some obvious weak points.

The experience at Penn State has been similar to that noted by the authors with regard to student reaction. The members of the teaching staff serve as consultants so that the students are compelled to develop self-reliance in meeting the situations involved in developing a solution to a problem. Comments by former students indicate that the techniques learned while a student in the applied machine-design course have given confidence in an approach to problems which have been given them in industry.

The authors are to be commended for the successful experiment involving industrial know-how in the classroom.

Authors' Closure

Dr. Jordan and I have been surprised and pleased by the interest shown in this educational experiment. We are grateful to Professor Gjesdahl for his kind and understanding comments.

D. G. Taylor[16] and R. C. Jordan.[17]

[16] Staff engineer, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.

[17] Professor and head, Department of Mechanical Engineering, University of Minnesota, Minneapolis, Minn. Mem. ASME.

BOOKS RECEIVED IN LIBRARY

Resistance de l'air et Théorie Cinétique des Gaz
By S. Travers. 1956, Eyrolles, Paris, France. 360 p., $6^1/_4 \times 9^3/_4$ in., paper. Fr. frcs. 2000. An extensive treatise on the kinetic and thermodynamic characteristics of air at high altitudes, above the operating range of aircraft. The effect of these conditions on projectiles is discussed in the light of known and derived data concerning meteorites. Several special fields of application are briefly discussed, including the artificial satellite. The mathematical bases for the above studies are dealt with in detail in extensive appendixes and a considerable bibliography is included.

Titanium
Published 1957 by F. S. Smithers & Company, New York, N. Y. 100 p., 6×9 in., paper. $5. A condensed presentation of the sources and availability, processing methods, production economics, utilization, and markets for titanium. There are also reviews of the activity of individual companies in the titanium field and other miscellaneous statistics.

Warmediagramme fur Vergasung, Verbrennung und Russbildung
By F. Bosnjakovic. 1956, Springer-Verlag, Berlin, Germany. 150 p., $6^3/_4 \times 10$ in., bound. DM 43.50. One hundred forty-five pages of explanatory text accompany 79 thermodynamic charts (mainly heat-entropy diagrams) for gasification, combustion of gases, and soot formation. With known operating conditions the diagrams enable the properties of the gas produced to be determined without calculation. In addition to predetermination of the properties of gases, the book explains the effect of operating conditions, the course of gasification or combustion, material and heat exchange, and the formation of soot.

L. P. Alford and the Evolution of Modern Industrial Management
By William J. Jaffe. 1957, New York University Press, New York, N. Y. 366 p., $6 \times 9^1/_2$ in., bound. $5. A historical account of Alford's contribution to the development of scientific management, based on his letters and unpublished manuscripts as well as on his published material and known activities. Alford's many interests resulted in the development of principles governing specialization, standardization, leadership and organization, production planning and control, materials handling, quality control and inspection, covering human as well as physical problems. The breadth of his character and activity is demonstrated by the appended bibliography of his writings.

Analytical Design of Linear Feedback Controls
By G. C. Newton, Jr., L. A. Gould, and J. F. Kaiser. 1957, John Wiley & Sons, Inc., New York, N. Y. 419 p., $5^3/_4 \times 9^1/_4$ in., bound. $12. The phrase "analytical design" is identified by the authors as the design of control systems by application of the methods of mathematical analysis to idealized models which represent physical equipment. Starting with the system specifications, the authors describe the input, the disturbances, and the desired response, including a statement of the basis on which the system performance will be judged. Separate chapters discuss the minimization of various errors which represent the performance index. An application of the analytical theory to a practical problem is fully discussed, and a working example of graphical procedures is also presented.

Centrifugal and Axial Flow Pumps
By A. J. Stepanoff. Second Edition, 1957, John Wiley & Sons, Inc., New York, N. Y. 462 p., $6 \times 9^1/_4$ in., bound. $12. In revising this practical treatment of the theory, design, and application of centrifugal, mixed-flow, and axial flow pumps the author has added a new chapter on water hammer in pumps and has expanded and rewritten the chapter on centrifugal-jet pump systems. He has also supplied a new viscosity correction chart, complete characteristics of mixed flow and axial flow pumps, and much other new material.

Corrosion and Wear Handbook for Water-Cooled Reactors
Edited by D. J. De Paul. 1957, McGraw-Hill Book Co., Inc., New York, N. Y. 293 p., $7^3/_4 \times 10^1/_2$ in., bound. $6. The first part of this handbook includes general discussions on the nuclear reactor plant and its relation to conventional power plants, considerations in choosing materials, fundamentals of corrosion and wear, and water technology. The second part provides tabulated data and detailed reference information on methods of testing and on the corrosion and wear resistance of various materials in different environments. The last part deals with special problems such as crevice, stress, and intergranular corrosion system, corrosion deposits, wear, and manufacturing problems. The book is one of a series sponsored by the Naval Reactors Branch of the Atomic Energy Commission.

Creep and Recovery
Published, 1957, by the American Society for Metals, Cleveland, Ohio. 372 p., $6 \times 9^1/_4$ in., bound. $6. A series of papers delivered at Cleveland in October, 1956. The papers cover thermodynamics, defects, and the recovery of various physical and mechanical properties including polygonization and the mechanism of annealing in neutron irradiated metals. The concluding papers deal with interaction of dislocations and vacancies, and with grain boundary behavior in creep of crystalline metals.

Daylight Through the Mountain
Edited by F. N. Walker and G. C. Walker, 1957, The Engineering Institute of Canada, Montreal, Canada. 442 p., $6^1/_4 \times 9^1/_2$ in., bound. $6. Told largely through the letters of two brothers, this is the story of two civil engineers who built all the early main-line railways in Canada and some in the United States. They completed the Hoosac Mountain tunnel in Massachusetts without loss of life, after other contractors had given up the work due to loss of several of their workmen. Eventually, one brother became a member of Parliament and the other the general manager of the Grand Trunk Railway from Montreal to Windsor, Ont.

Elements of Heat Transfer
By Max Jakob. Third Edition Revised by G. A. Hawkins. 1957, John Wiley & Sons, Inc., New York, N. Y. 317 p., $6 \times 9^1/_4$ in., bound. $6.75. The reviser of this book has maintained the emphasis on basic principles of previous editions but has changed the subject matter freely to meet the needs of today's engineering students. Some of the changes are: A new section on equivalent circuits for solving heat-transfer problems, revision of the chapter on free convection, a new section on gas radiation, and a new chapter on mass transfer. New references and new problems have also been added.

Engineering Metallurgy
By the Committee on Metallurgy. 1957, Pitman Publishing Corp., New York, N. Y. 516 p., $6 \times 9^1/_4$ in., bound. $7.80. This is a concise, up-to-date, and authoritative presentation of the essentials of the subject, useful to all engineers, student and practicing. Produced by a group of 40 professors actually engaged in teaching metallurgy, the book deals in chapters 1 through 6 with general principles as related to engineering, 7 through 10 with nonferrous metals, and 11 through 20 with iron and steel. Machinability, corrosion, and the effects of temperature are covered in the last three chapters. The text is liberally illustrated with photographs and drawings, and sets of exercises and problems are provided at the end of each chapter.

Fluglehre
By Richard von Mises. Sixth Edition revised by Kurt Hohenemser. 1957, Springer

Verlag, Berlin, Germany. 402 p., $5^3/_4 \times 8^1/_2$ in., bound. DM 25.50. Originally intended for pilot training, this introductory text on the theory and design of airplanes covers the following topics: general data on air forces and air resistance; wing structures; motorless flight; the propeller; the power plant; airplane performance; controls and stability; take-off and landing; helicopters; navigation and transportation.

Die Induktive Warmebehandlung

By Walter Brunst. 1957, Springer Verlag, Berlin, Germany. 240 p., 7 × 10 in., bound. DM 43.50. A practical text on induction heat treatment, with special regard to the hardening of steels. Following the introductory chapters on electrical and thermodynamic fundamentals, the book deals with the construction of coils and equipment, the transformer, the economics of induction heating methods, and surface hardening of steels. Both graphic and tabular presentations of data are extensively used throughout the book for more effective reference use.

Industrieofenbau

By J. Henri Brunklaus. 1957, Vulkan-Verlag Dr. W. Classen, Essen, Germany. 383 p., $6 \times 8^1/_2$ in., bound. DM 46. A new, comprehensive treatment of the principles and construction of industrial furnaces. Although the most extensive consideration is given to metal-treating furnaces, other types are covered as well, including drying ovens, baking ovens, infrared devices, low-pressure gas burners, etc. A list of book titles is appended, and periodical literature references are included as footnotes or as chapter bibliographies.

An Introduction to Fluid Mechanics and Heat Transfer

By J. M. Kay. 1957, Cambridge University Press, New York, N. Y. 309 p., $5^1/_2 \times 8^3/_4$ in., bound. $7. Emphasizing the common theoretical basis of heat transfer and fluid mechanics, this text presents first the fundamental ideas of fluid flow, viscosity, heat conduction, diffusion, energy and momentum principles, and dimensional analysis. These ideas are then developed in terms of practical applications: flow in pipes and channels, pumps, heat exchangers, etc. Later chapters deal with more specialized topics such as turbulence, forced convection, solid particles in fluid flow, flow in packed beds, condensation, and evaporation.

An Introduction to Reactor Physics

By D. J. Littler and J. F. Raffle. Second Edition. 1957, Pergamon Press, New York, N. Y. 208 p., $5^3/_4 \times 8^3/_4$ in., bound. $5.50. A presentation of the calculations used in evaluating the critical size of a gas-cooled, graphite moderated, natural uranium reactor of the type used in the nuclear energy power program in Great Britain. The physics essential for the understanding of the construction of this and other types of reactors are covered. In this edition the text has been simplified and rearranged, and numerous additions and corrections have been made as a result of the release of data at the Geneva Conference, in 1955.

Magnetohydrodynamics

Edited by Rolf K. M. Landschoff. 1957, Stanford University Press, Stanford, Calif. 115 p., $6^1/_4 \times 9^1/_2$ in., bound. $4. Magnetohydrodynamics is the study of how magnetic fields influence and are influenced by ionized gases. In this book, an outgrowth of a symposium sponsored by the Lockheed Missile Systems Division in 1956, some of the theoretical and experimental work done in the field is presented in a group of papers by various authorities. Subjects of the papers include magnetically driven shock waves, penetration of a shock wave into a magnetic field, liquid sodium instability, and the hydromagnetic wave guide.

Proceedings of the Conference on Operations Research, Computers, and Management Decisions

Sponsored and published 1957 by the Operations Research Group, Department of Engineering Administration, Case Institute of Technology, Cleveland, Ohio. 97 p., $8^1/_2 \times 11$ in., paper. $5. As stated in the foreword, "Of particular interest to management are the economical design of effective data processing systems and the use of computers in decision making and control. In these connections there are problems of installation and operating costs, data collection methods, research utilization of machine time, etc." The ten papers included in this volume deal with some general or special aspect of the above designated field of interest, with the intent of exploring some of the potentialities of operations research and electronic computer facilities.

Schnitt-, Stanz- und Ziehwerkzeuge

By Gerhard Oehler. Third Edition. 1957, Springer Verlag, Berlin, Germany. 561 p., $6^1/_2 \times 9^1/_2$ in., bound. DM 39. A detailed description of the construction and use of cutting, blanking, and drawing tools. Of the material added in the new edition, special note should be made of the results of recent model tests, of equipment devised for automated plants, and of the included data on the application of various tools to titanium sheet.

The Solidification of Castings

Published as Monograph and Report Series No. 7, Second Edition, 1957, by the Institute of Metals, London, England. 406 p., $5^3/_4 \times 8^3/_4$ in., bound. Price not given. A critical summary of researches on the theory of the mechanism of the solidification of castings and on important practical aspects of casting technology. The study covers experimental methods; the flow of heat in castings and molds; freezing rates in sand and chill castings; and rates of heat flow and solidification in the continuous process. The final chapter is devoted to such practical matters as the relation between conditions of solidification and soundness of castings, causes of porosity, the mechanism of feeding, and methods for improving the soundness of castings. Over 300 references are listed at the end of the book.

Die Strahlungsheizung

By A. Kollmar and W. Liese. Fourth Edition. 1957, R. Oldenbourg, Munich, Germany. 562 p., $6^1/_2 \times 9^1/_2$ in., bound. DM 64. This treatise on radiant heating covers panel, radiator, and infrared heating. It reviews the fundamental theory and recent developments in the design and construction of radiant heating installations, and also discusses both the theoretical and practical physiological aspects. A 60-page appendix provides graphic and tabular data for ready-reference use by the designer.

Work Sampling

By Ralph M. Barnes. Second Edition, 1957. John Wiley & Sons, Inc., New York, N. Y. 283 p., $5^3/_4 \times 9^1/_4$ in., bound. $7.95. An analysis of work sampling for establishing time standards for manual tasks is presented in this reference and guide to work-sampling studies. The book covers the results of research in the field from Tippett's fundamental work on the ratio-delay method of measuring idle time. It shows how to apply measurement techniques in an individual office or factory, and it includes a bibliography and case histories of actual situations.

ASTM Standards on Coal and Coke

Published 1957 by the American Society or Testing Materials, Philadelphia, Pa. 134 p., 6 × 9 in., paper. $2.50. A convenient compilation of 25 standards covering methods of testing, definitions, and specifications for coal and coke, and the standard specifications for the classification of coal. Sampling methods, sieve specifications, and three specifications on fly ash are included. Four of the standards are new or revised.

ASTM Standards on Copper and Copper Alloys

Published 1957 by the American Society for Testing Materials, Philadelphia. Pa. 674 p., 6 × 9 in., paper. $6.25. A convenient compilation of the methods of test and specifications pertaining to copper and copper-alloy sheet, strip, bar, shapes, wire, pipe and tube, copper and copper-alloy electrical conductors, copper castings, and nonferrous metals used in copper alloys. Some 130 standards are included of which 34 have been revised since the last compilation in 1955. The standards are grouped in broadly classified sections with a subject index, and also a listing in numerical sequence.

Applied Probability

Proceedings of the Seventh Symposium on Applied Mathematics, 1955. Published 1957 by McGraw-Hill Book Company, Inc., New York, N. Y. 104 p., $6^3/_4 \times 10^1/_4$ in., bound. $5. Sponsored by the American Mathematical Society and the Office of Naval Research, this symposium consists of nine papers as follows: Brownian motion depending on N parameters; the first boundary-value problem; boundaries defined by stochastic matrices (abstract); application of functional calculus to the statistical theory of turbulence; stochastic processes of astronomical interest; singularity in the spectrum of homogenous turbulence; probability in classical physics; infinite models in physics; and quantum theory and the foundations of probability.

Dangerous Properties of Industrial Materials

By N. Irving Sax. 1957, Reinhold Publishing Corporation, New York, N. Y. 1467 p., 7 × $10^1/_4$ in., bound. $22.50. Over 8500 hazardous industrial materials, including trade-name products, are covered in this new edition of the book formerly called "Handbook of Dangerous Materials." Over 1000 pages are devoted to the alphabetical general chemical section, with nine smaller sections on toxicology, ventilation control, personnel protection and personal hygiene, atmospheric pollution, radiation hazards, industrial fire protection, storage and handling of hazardous materials (explosives, etc.), reactor safeguards, and allergic disease in industry. Detailed information is given on hazardous properties and situations, safety precautions, symptoms and treatments, shipping regulations, and the important characteristics of the individual materials. The encyclopedic arrangement of the volume and an extensive cross-reference system provide ready access to the information contained in the volume.

Handbook of Noise Control

Edited by Cyril M. Harris. 1957, McGraw-Hill Book Co., Inc., New York, N. Y. Various pagings, $6^1/_2 \times 9^1/_2$ in., bound. $16.50. Forty chapters with accompanying lists of references, provide comprehensive coverage of the nature of noise, its measurement, and techniques of its control in buildings, industry, transportation, and the community. Prepared by 46 experts, the handbook treats vibration isolation, damping, and measurement-

acoustical filters and mufflers; special types of noise such as that in bearings, gears, fans, water systems, and electric motors; and physiological, psychological, and legal aspects of noise. Examples from existing installations illustrate the application of methods for solving problems of noise control.

The Making, Shaping, and Treating of Steel
Seventh Edition. Published, 1957, by the United States Steel Co., Pittsburgh, Pa. 1048 p., 8 × 11 in., bound. $7.50. The result of the co-operative effort of some 200 of the technical and research personnel of the U. S. Steel Co., this standard reference work has again been thoroughly revised and largely rewritten. The information contained is a compilation of past and present practices in the iron and steel industry, based on practical experience. In addition to the extensive coverage of the processes named in the title, the work covers fundamental chemical and physical principles, fuels and combustion, metallurgical coke production, recovery of coal chemicals, iron ores, refractories, fluxes and slags, sponge and wrought iron, special steels, and mechanical testing methods. The detailed 110-page index provides easy and rapid reference to the text material. The increase in the size of the book has reduced the number of pages but not the quality or coverage of the contents.

Mécanique des Fluides Théorique
By Maurice Giqueaux. Second Edition, 1957. Librairie Polytechnique Ch. Béranger, Paris, France. 413 p., $6^1/_4 \times 9^3/_4$ in., bound. Fr. frcs. 8800. A thorough treatment of the mathematical theory of fluid mechanics covering the general kinematics and dynamics of fluids, laminar and turbulent flow of viscous fluids, incompressible fluid flow under various conditions, vortexes, flow around isolated singularities, and some aerodynamic aspects.

Nichtstationare Vorgange in den Zuleitungs- und Ableitungskanalen von Wasserkraftwerken
By Josef Frank. Second Edition, 1957. Springer-Verlag, Berlin, Germany. 333 p., $6^1/_4 \times 9^1/_4$ in., bound. DM 48.00. A specialized treatment of nonsteady-state phenomena in inlet and diversion channels of hydroelectric plants. The two main sections deal respectively with translation waves in open channels and with surge tanks in pressure conduits. Special reference is made to underground hydroelectric plants and pumped-storage stations. Both parts contain fairly extensive surveys of the pertinent literature.

Notes on Analog-Digital Conversion Techniques
Edited by Alfred K. Susskind. 1957, The Technology Press, Massachusetts Institute of Technology, Cambridge, Mass. Various paging, 6 × 9 in., paper, $10. Designed for the practicing engineer, this book provides the necessary background for readers who do not have previous experience in the field. It includes an introduction to the theory of sampling, quantizing, and coding; detailed analysis and evaluation of basic coding and decoding methods for electrical and mechanical analog quantities; a case study showing how basic principles were applied in a digital flight-test instrumentation system.

Nuclear Power Reactors
Edited by James K. Pickard. 1957, D. Van Nostrand Co., Inc., Princeton, N. J. 388 p., 6 × $9^1/_4$ in., bound. $8.50. Selected and arranged information from the papers presented at the Geneva Conference. After a discussion of the present outlook for heavy power production from nuclear sources the book covers basic facts on reactor design and construction, and a comparison of various types as power producers. An extensive chapter is devoted to economic considerations, and detailed studies are presented of the different types of reactors.

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La Pratique des Traitements Thermiques des Métaux Industriels
By Gérard de Smet. Fifth Edition, 1957. Dunod, Paris, France. 460 p., 6 × $9^3/_4$ in., bound. Fr. frcs. 3300. A comprehensive, practical book on the heat treatment of industrial metals. The introductory chapters of part 1 are a brief review of the metallurgical characteristics of iron, cast iron, and steel, followed by a detailed description of heat-treating methods, with special attention to tool steels and other industrial applications. Part 2 covers the same ground with respect to aluminum and aluminum alloys, copper alloys, and bearing metals. Separate chapters are devoted to special surface treatments, furnaces, temperature measurement, and metal testing.

Principles of the Properties of Materials
By Jacob P. Frankel. 1957, McGraw-Hill Book Co., Inc., New York, N. Y. 228 p. 6 × $9^1/_4$ in., bound. $6. A study of the properties of materials which utilizes a new approach by emphasizing principles and properties rather than treating materials separately. The properties dealt with in separate chapters are conductivity, heating, diffusivity, electrochemistry, elasticity, plasticity, fracture, viscosity, and general considerations of crystallinity. An introductory section on physicochemical foundations deals with atoms, equilibrium, structure, cohesion, and the electron theory of metals.

Symposium on Radiation Effects on Materials
ASTM Special Technical Publication No. 208. Published 1957 by the American Society for Testing Materials, Philadelphia, Pa. 190 p., 6 × $9^1/_4$ in., bound. $4.75. The first of a series of symposiums on this subject, sponsored jointly by ASTM and the Atomic Industrial Forum. The 16 papers included deal with theory, radiation facilities and mechanics of testing, and with experimental work both on fuel and graphite materials and structural materials. Radiation effects on plastics, organic materials, plain-carbon steels, stainless steel, and copper-iron alloys are discussed.

Symposiums on Seismic and Shock Loading, Glued-Laminated and Other Constructions
ASTM Special Technical Publication No. 209. Published 1957 by the American Society for Testing Materials, Philadelphia, Pa. 85 p., 6 × $9^1/_4$ in., bound. $2.75. Three of the papers in this combined publication deal with building design for lateral forces and with the results of laboratory tests on full-size wooden structural elements particularly with reference to lateral shock resistance. The other five papers report on the development of glued-laminated, stressed-skin, and sandwich constructions with wood as the material. Technical information is also included on factors affecting the characteristic and properties of wood.

Thermal Stresses
By B. E. Gatewood. 1957, McGraw-Hill Book Co., Inc., New York, N. Y. 232 p., 6 × $9^1/_4$ in., bound. $7.50. Although primarily prepared for aeronautical engineers, anyone concerned with thermal stresses will find useful information in this book which touches on all phases of the structural design problem—temperature distribution, elastic and inelastic thermal stresses in various structures, allowable stresses for various materials and loading conditions, and the buckling, deflection, stiffness, fatigue, shock, and flutter effects of elevated temperatures. Aircraft structures are emphasized, with sections on stresses in turbine blades, turbine disks, and nuclear reactors included to give an idea of the problems in jet-engine and nuclear reactor design.

Die Verbrennungskraftmaschine
Vol. 7. Gemischbildung und Verbrennung im Dieselmotor. By A. Pischinger and F. Pischinger. Second Edition, 1957. Springer-Verlag, Vienna, Austria. 206 p., $7^1/_2 \times 10^1/_2$ in., paper. $11.45. A comprehensive treatment of mixture formation and combustion in diesel engines. Part A contains a general discussion of ignition and combustion. Part B, concerned with mixture formation, covers basic theory, fuel jets, and combustion chambers. Part C provides a detailed treatment of the characteristics and operation of injection systems: nozzles, pumps, etc. Extensively illustrated by diagrams, cross-sections, and shadowgraphs.

Le Calcul des Tuyauteries a Haute Température
By A. Gage. 1957, Dunod, Paris, France. 166 p., $8^1/_2 \times 10^1/_2$ in., paper. Fr. frcs. 2900. The growing use of extensive piping systems of increasing complexity and under conditions of high pressures and temperatures necessitates design methods to establish the most economic lengths and pipe thicknesses for various installations. This work provides first a theoretical treatment of the problem, and following this a section on practical application. Arranged for solution by an electronic computer, the book gives symbolic representations for 40 different combinations of joints, anchorages, and constraints, and one fully worked out design problem.

Design of Die Castings
By Gustav Lieby. Translated from the German by Hubert and Elmar R. Altwicker. 1949, American Foundrymen's Society; Gold and Wolf Roads, Des Plaines, Ill. 199 p., 6 × 9 in., paper. $8. Specific and practical information on materials, mold design, and casting techniques, including descriptions and a comparison of the hot and cold-chamber processes; data on lead, tin, zinc, aluminum, magnesium, copper, and silver-base alloys; and detailed suggestions for die design and construction. Appended to the translation, originally published in 1949, is a 20-page bibliography of references published 1949–1956.

Digital Differential Analyzers. An Applications Manual for Digital and Bush-Type Differential Analyzers
By George F. Forbes. Fourth Edition, 1957.

Published by George F. Forbes, 10117 Bartee Avenue, Pacoima, Calif. Various paging, $8^3/_4 \times 11$ in., paper. $5. Basic integrator mechanisms for the generation of exponential, trigonometric, algebraic, and inverse trigonometric functions are shown, and adders and servos, and their uses discussed. Applications to scientific and engineering problems are illustrated, especially in chapters dealing with the calculation of the trajectory of an interplanetary rocket, curve analysis, and various common functions. This edition is reproduced from the third edition with additions and corrections.

Engineering Progress and the Oil Industry

Report of the Summer Meeting of The Institute of Petroleum, 1957. Published 1957 by the Institute, London, England. 168 pages, $5^3/_4 \times 8^3/_4$ in., bound. 30s. The seven papers included in this volume reflect the mutually stimulating influence of the petroleum industry on other engineering fields. The several authors itemize and discuss the contributions of civil, mechanical, electrical, marine, chemical, and metallurgical engineering to the developments in design and fabrication of the modern petroleum plant and its equipment.

Fundamentals of Hydro and Aeromechanics. Applied Hydro and Aeromechanics

By O. G. Tietjens, based on lectures of L. Prandtl. 1957, Dover Publications, Inc., New York, N. Y., 270 p., 311 p., $5^1/_4 \times 8$ in., paper. $1.85 each. These are unabridged and unaltered reproductions of two books first published as Engineering Societies Monographs in 1934. They have been out-of-print for several years.

Gas Turbine Materials

By G. Lucas and J. F. Pollock. 1957, Temple Press, Ltd., London, England. 163 p., $5^3/_4 \times 8^3/_4$ in., bound. 25s. Intended to bridge the gap between the metallurgical textbooks and those on gas-turbine design, this volume provides a survey of high-temperature materials chiefly in the field of metallic alloys. Their development is outlined, the behavior of metals under stress and temperature is discussed, followed by the application of high-temperature materials. The influence of fuel and of performance requirements on operating conditions is dealt with, and the final chapter takes up the manufacture of gas-turbine components.

Handbook of Layout and Dimensioning for Production

By Hyman H. Katz. 1957, The Macmillan Co., New York, N. Y. 479 p., $6 \times 9^1/_2$ in., bound. $15. A practical guide to layout, detail design, and production dimensioning practices in the metalworking industries. Each step in product development from technical sketch to final drawing is illustrated and detailed in terms of the procedures, principles, and theory involved.

A History of Technology

Vol. 3: From the Renaissance to the Industrial Revolution, c. 1500–c. 1750. Edited by Charles Singer and others. 1957, Oxford University Press, New York, N. Y. 766 p., $7^1/_4 \times 10$ in., bound. $26.90. The third of a five-volume history which will cover the subject from the Old Stone Age to the later nineteenth century. The present volume gives due attention to the pendulum clock, inquiries into the properties of metals, and to improvements in scientific instruments—developmens of significance for future centuries—as well as to the great wooden ships, huge machines for raising water, and massive stone buildings that were the culmination of long technological traditions. Like others in the series, the volume is superbly printed and illustrated.

Installing Electronic Data Processing Systems

By Richard G. Canning. 1957, John Wiley & Sons, Inc., New York, N. Y. 193 p., $5^3/_4 \times 9^1/_4$ in., bound. $6. By means of a generalized case study combining the experiences of a number of companies, the author shows how to analyze and solve the problems that are involved in planning for installation, programming, installation, conversion to electronic data processing, and in early phases of operation. The conversion of production specification, parts requirements, work-in-process, employee, machine, and other files is treated.

Materials Handling Equipment

By D. Oliphant Haynes. 1957, Chilton Co., Philadelphia, Pa., 636 p., $6 \times 9^1/_2$ in., bound. $17.50. Virtually an encyclopedia of materials-handling equipment, this volume shows how the various machines function and what they can do. Six of the seven sections are devoted to principal types of machinery—transporting, elevating, conveying, transferring, self-loading, and bulk-handling. A seventh section is devoted to accessories. Over 2000 line drawings illustrate the internal parts of the machines discussed.

Sixth Symposium (International) on Combustion

Held at Yale University, New Haven, Conn., August 19–24, 1956, by The Combustion Institute. 1957, Reinhold Publishing Corp., New York, N. Y. 943 p., $6^3/_4 \times 10^1/_4$ in., bound. $28. The principal subjects covered in this collection of 129 papers are: Structure and propagation of laminar flames; structure and properties of turbulent flames; high-speed reactions; flame stabilization in fast streams; instability in combustion chambers; combustion of solid fuels; combustion of explosives and solid propellants; evaporation and combustion of droplets and sprays; experimental and analytical techniques; and applications. The volume as a whole is an important source of information on recent advances in the combustion field.

The Spectroscopy of Flames

By A. G. Gaydon. 1957, John Wiley & Sons, Inc., New York, N. Y. 279 p., $6^1/_4 \times 9^1/_2$ in., bound. $9. Extending and bringing up to date the author's previous treatment of the subject, this volume covers new experimental techniques for controlling flames or for exciting flame-type spectra in special sources, including new burner types, low-pressure flames, flames supported by free atoms, isotope tracer methods, etc. It deals with flames supported by fluorine and other halogens, and by oxides of nitrogen as well as by air and oxygen. More than 400 references are cited in this coverage of a wide range of flame investigation.

Techniques of Plant Maintenance and Engineering, 1957

Published by 1957 Plant Maintenance Show, Inc., New York, N. Y. 273 p , $8^1/_4 \times 11^1/_4$ in., bound. $10. This book is a record of the technical sessions held concurrently with the eighth National Plant Maintenance and Engineering Show, Cleveland, 1957. It contains 31 papers with discussions covering many phases of maintenance: Power-distribution equipment, small plant maintenance, rotating electrical machinery, training personnel, cost controls, and a wide range of maintenance problems in various plants such as metalworking, steel mills, foundries, paper mills, petroleum refineries, and rubber mills.

Welding Handbook

Fourth Edition, section one. 1957, American Welding Society, New York, N. Y. Various pagings, $6^1/_4 \times 9^1/_4$ in., bound. $9. This standard reference work is now to appear in five volumes, of which this is the first. It contains the fundamentals of welding: Terms, general engineering tables, welding metallurgy, properties of welded joints and treatment of weldments, cost estimation, inspection and testing methods, statistical control of weld quality, and safety practices. An extensive and detailed index provides quick references to the contained information.

Annual Review of Nuclear Science, 1957

Edited by James G. Beckerley and others. 1957, Annual Reviews, Inc., Palo Alto, Calif. 496 p., $6^1/_4 \times 9$ in., bound. $7. The present volume, the seventh in the series, contains reviews of advances, and of the literature on 12 topics. Two of the papers, approximately one-fourth of the volume, deal with meson physics; the remainder, with such topics as radiochemical separations by ion exchange, high-level radiochemical processes, vertebrate radiobiology (lethal effects and pathology), the collective model of nuclei, scattering of high-energy electrons, and measurement of nuclear spins and static moments of radioactive isotopes.

Automation in Practice

By S. E. Rusinoff. 1957, American Technical Society, Chicago, Ill. 261 p., $5^3/_4 \times 8^1/_2$ in., bound. $6.50. The treatment in this integrated survey is primarily in terms of particular processes rather than particular industries or products. Basic principles are discussed first: Self-regulation, negative feedback, the theory of closed-loop control systems, and other aspects. These principles are then given concrete application in the major types of control devices employed in the automated and semiautomated plant with emphasis on metal production.

Electrostatics in the Petroleum Industry

Edited by A. Klinkenberg and J. L. Van Der Minne. 1958. Elsevier Publishing Company, Amsterdam, Holland; distributed by D. Van Nostrand Co., Inc., Princeton, N. J. 191 p., $8^1/_2 \times 12$ in., bound. $7. Static electricity is a recognized hazard in the petroleum industry. This book discusses the ways in which static electricity if produced, explains the causes of explosions and fires, and describes the methods and results of research on the subject. Preventive methods are indicated, in particular the use of antistatic additives.

Handbook for Welding Design Vol. I

Edited by C. R. Harman. Published 1956 for the Institute of Welding by Sir Isaac Pitman & Sons, Ltd., London, England. 305 p., $5^1/_2 \times 8^3/_4$ in., bound. 45s. A handbook devoted to the design of products fabricated in mild or low alloy steels by the metal-arc welding process. Wherever possible this information is based on the relevant British standards or other recognized equivalent. The first volume is intended to provide the designer of a welded assembly with the data necessary to design a product both economical and of standard quality. Included are choice of materials, properties of sections, classification of electrodes, types of welded joints, design of welds, typical assemblies, and welding costs.

Ideas, Inventions, and Patents

By Robert A. Buckles. 1957, John Wiley & Sons, Inc., New York, N. Y. 270 p., $6 \times 9^1/_4$ in., bound. $5.95. The fundamental principles and philosophy of patent and trademark protection are presented with a view to providing more effective protection and exploitation of ideas and inventions. It is primarily

directed at the engineer and scientist engaged in research and development activities. The author discusses the principles underlying patents in all fields of technology and then gives specific applications in each area. There is a complete case history of a simple invention providing a guide for readers who have had no previous experience with the Patent Office or with patent attorneys.

Information Systems in Documentation

Advances in Documentation and Library Science. Vol. 2. Edited by J. H. Shera and others. 1957, Interscience Publishers, Inc., New York, N. Y. 639 p., 6 × 9¼ in., bound. $12. This is a useful compilation of symposium papers covering most of the major systems of information retrieval now in use, and in many instances these systems are represented by case histories and specific applications which may be extended and adapted to other uses. The papers are divided into six major divisions: fundamentals in systems design; documentation problems in specialized fields; semiautomatic systems; systems using accounting or statistical machines; systems using computers or computerlike devices; co-operative information processing.

Mechanical Engineering Problems

Solutions to Professional Engineer Examinations, New York State, Mechanical Engineering, Part III. By William Glendinning. 1957. Published by the author, 5123 Bell Blvd., Bayside, N. Y. 84 p., 8½ × 11 in., paper. $3. A group of fully worked out solutions to problems selected from past examinations, designed to assist engineers in preparing for State Board examinations. They illustrate a wide range of basic work in mechanical engineering: steam generation and stations; refrigeration, heating, and air conditioning; thermodynamics and heat transfer; fluid flow and other problems in hydraulics; shafts, springs, and vibration; supersonic air flow; etc.

Mechanics of Machinery

By C. W. Ham and others. 1958, McGraw-Hill Book Co., Inc., New York, N. Y. 509 p., 6¼ × 9¼ in., bound. $8.50. This text dealing with the mechanics, kinematics, and dynamics of machinery has again been revised and brought up to date while retaining the emphasis on fundamental principles and methods. In addition to the text revision, new problems and illustrations have been added, and the symbols and terminology have been brought into conformity with those advocated by American Standards Association.

ASME BOILER AND PRESSURE VESSEL CODE

Interpretations

THE Boiler and Pressure Vessel Committee meets regularly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler and Pressure Vessel Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting April 25, 1958, and approved by the Board on June 30, 1958.)

Annulment of Cases

The following case is annulled:

Case No.	Reason for Annulment
1182	No longer necessary

Case No. 1245

(Special Ruling)

(Use of Rupture Disks in Nuclear Systems)

Inquiry: May a low-pressure rupture disk be used in the discharge pipe immediately adjacent to the steam safety valve outlet in a nuclear system to prevent atmospheric pollution which might result from small intermittent or persistent safety valve leakage when the safety valves are arranged to discharge into the containment vessel in which the nuclear system is located?

Reply: It is the opinion of the Committee that the use of a low-pressure rupture disk in the discharge pipe immediately adjacent to the steam safety valve outlet in a nuclear system to prevent atmospheric pollution in the containment vessel which might result from small intermittent or persistent safety valve leakage is permissible if the following conditions apply:

a. The rupture disk shall be designed to burst at a maximum of 13 psi, including manufacturing tolerances.

b. The safety valve settings are reduced so that the valve setting plus 13 psi shall not exceed the design pressure of the reactor or its steam separating drum.

c. The internal diameter of the disk holder shall at least be equal to that of the safety valve discharge connection so that when the disk bursts there will be no restriction on the safety valve discharge.

d. The rupture disk holder shall be designed to include a 1 in. drain opening on its inlet side. This drain opening shall be coupled to the required drain opening at the lowest point in the outlet of the safety valve body. The combined drains shall be piped to a suitable drain tank.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

AS NEED arises, the Boiler and Pressure Vessel Committee entertains suggestions for revising its Code. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Power Boilers, 1956

PAR. P-102(h)(4) Revise to read:

The film during exposure shall be as close to the surface of the weld as practicable. If possible, this distance shall be not greater than 1 in. The ratio s/f, where s is the distance from the radiation side of the weld to the source of radiation and f is the distance from the radiation side of the weld to the film, shall be as large as practicable consistent with economy and physical limitations, but need not be greater than 7 to 1. When the s/f ratio is less than 7 to 1, the manufacturer shall satisfy the inspector that the technique employed in doing the work is known to be adequate.[1] In all cases when the s/f ratio is less than 7 to 1, the ratio shall be clearly indicated directly

on each film or by attaching the information thereto.

PAR. P-102(h)(4) and (h).(9) Revise Footnote 1 to read:

[1] Note: A test radiograph shall be made under substantially identical conditions as will be present on production radiography. Penetrameters shall be placed on both the radiation side and the film side, sufficiently staggered to obtain separate images. Each penetrameter should be provided with a marker which will show clearly on the film and which will indicate the side of the joint on which it is located: *f* for the film side and *s* for the radiation side. The smallest hole shall be distinguishable on both the *f* and the *s* penetrameters. The difference of penetrameter images indicates degree of distortion.

PAR. P-102(h)(9) Revise to read:

Penetrameters may be placed on the film side of the joint provided the manufacturer can satisfy the inspector that the technique employed is known to be adequate.[1]

Low Pressure Heating Boilers, 1956

PAR. H-7 Renumber this paragraph as Par. H-7(a) and add a new Par. H-7(b) as follows:

(b) Castings for use in copper and copper alloy water tube type boilers shall conform to Specification SB-61 or SB-62.

PAR. H-29 Revise the first paragraph to read:

Washout plugs shall be not smaller than $1^1/_2$ in. pipe size.

Miniature Boilers, 1952

PAR. M-1 Definition Revise the first paragraph to read:

The classification "miniature" applies to fired pressure vessels, fired and unfired boilers, which do not exceed any of the following limits:

16 in. inside diameter of shell,
5 cu ft gross volume, exclusive of casing and insulation,
20 sq ft water heating surface,
100 psi gage maximum allowable working pressure

Unfired Pressure Vessels, 1956

PAR. UG-9 Letter present paragraph as Par. UG-9(a) and add a new Par. UG-9(b) as follows:

(b) Integrally finned tubes made from tubes that conform in every respect with one of the specifications given in Section II, Material Specifications, of the Code may be used under the following conditions:

(1) The tubes after finning shall have a temper or condition which conforms to one of those provided in the governing specifications.

(2) The maximum allowable stress value for the finned tube shall be that given in Subsection C for the tube before finning, except as permitted in (3).

(3) The maximum allowable stress value for a temper or condition that has a higher stress value than that of the tube before finning may be used provided that qualifying tensile tests demonstrate that such a temper or condition is obtained. The qualifying tensile tests shall be made on specimens of finned tube from which the fins have been removed by machining.

(4) The maximum allowable internal or external working pressure of the tube shall be based on the minimum wall thickness of the finned section or of the unfinned section, whichever is smaller.

(5) In addition to the tests required by the governing specification, each tube after finning shall withstand without evidence of leakage an internal pneumatic test of not less than 250 psi for five seconds while immersed in water or other suitable liquid.

PAR. UG-29(a) Add the following new definition to nomenclature:

L_s = one-half of the distance from the centerline of the stiffening ring to the next line of support on one side, plus one-half of the center line distance to the next line of support, if any, on the other side of the stiffening ring, both measured parallel to the axis of the vessel, in. A line of support is (1) a stiffening ring that meets the requirements of this paragraph, (2) a circumferential connection to a jacket, or (3) a circumferential line on a head at one-third the depth of the head from the head-bend line, as shown in Fig. UG-28.

Also in the last line of the nomenclature delete the letter "L."

In the two formulas of this paragraph and also under Step 1, revise "L" to read "L_s."

PAR. UA-272 In the formula at the top of Page 163, "L" should be revised to "L_s."

PAR. UW-51(f) Revise to read:

The film during exposure shall be as close to the surface of the weld as practicable. If possible, this distance shall be not greater than 1 in. The ratio s/f, where s is the distance from the radiation side of the weld to the source of radiation and f is the distance from the radiation side of the weld to the film, shall be as large as practicable consistent with economy and physical limitations, but need not be greater than 7 to 1. When the s/f ratio is less than 7 to 1 the manufacturer shall satisfy the inspector that the technique employed in doing the work is known to be adequate.[1] In all cases when the s/f ratio is less than 7 to 1, the ratio shall be clearly indicated directly on each film or by attaching the information thereto.

MATERIALS AND STRESS VALUES TO BE ADDED TO TABLE UCS-23

Material and Specification Number	Grade	Nominal Composition	P Number	Spec Min Tensile	Notes	For Metal Temperatures Not Exceeding Deg F: —20 to 650	700	750	800	850	900	950
PLATE STEELS												
Carbon Steels												
SA-414	A	...	1	45000	(2)(4)	11250	11000	10250	9000	7750	6500	...
SA-414	B	...	1	50000	(2)(4)	12500	12100	11150	9600	8050	6500	...
SA-414	C	...	1	55000	(2)(4)	13750	13250	12050	10200	8350	6500	...
Low-Alloy Steels												
SA-410	...	Cr-Cu-Ni-Al		60000	...	15000	...	...	...	...	...	...
PIPES & TUBES												
Seamless Low-Alloy												
SA-333	4	Cr-Cu-Ni-Al		60000	...	15000	...	...	...	...	...	...
FORGINGS												
Low-Alloy Steels												
SA-350	LF4	Cr-Cu-Ni-Al		60000	...	15000	...	...	...	...	...	...

Material and Specification Number	Grade	Type	Nominal Composition	Spec Min Tensile	Notes	For Metal Temperatures Not Exceeding Deg F: —20 to 100	200	300	400	500	600	650
PLATE STEELS												
SA-240	..	302	18Cr-8Ni	75000	(1)(10)	18750	17000	16000	15450	15100	14900	14850
SA-240	..	302	18Cr-8Ni	75000	(10)	18750	16650	15000	13650	12500	11600	11200
SA-240	..	304	18Cr-8Ni	75000	(1)(10)	18750	17000	16000	15450	15100	14900	14850
SA-240	..	304	18Cr-8Ni	75000	(10)	18750	16650	15000	13650	12500	11600	11200
SA-240	..	304L	18Cr-8Ni	70000	(1)	17500	17000	16000	15000	14000	13000	12500
SA-240	..	304L	18Cr-8Ni	70000	..	17500	15300	13100	11000	9700	9000	8750
SA-240	..	309S	23Cr-13Ni	75000	(10)	18750	18750	17300	16700	16600	16500	16450
SA-240	..	310S	25Cr-20Ni	75000	(2)(10)	18750	18750	18500	18200	17700	17200	16900
SA-240	..	310S	25Cr-20Ni	75000	(3)(10)	18750	18750	18500	18200	17700	17200	16900
SA-240	..	316	18Cr-10Ni-2Mo	75000	(10)	18750	18750	17900	17500	17200	17100	17050
SA-240	..	316L	18Cr-10Ni-2Mo	70000	(1)	17500	17500	15800	14750	14000	13600	13450
SA-240	..	316L	18Cr-10Ni-2Mo	70000	..	17500	16250	14500	12000	11000	10150	9800
SA-240	..	317	19Cr-13Ni-3Mo	75000	(10)	18750	18750	17900	17500	17200	17100	17050
SA-240	..	321	18Cr-10Ni-Ti	75000	(10)	18750	18750	17000	15800	15200	14900	14850
SA-240	..	347	18Cr-10Ni-Cb	75000	(10)	18750	18750	17000	15800	15200	14900	14850
SA-240	..	348	18Cr-10Ni-Cb-Ti	75000	(10)	18750	18750	17000	15800	15200	14900	14850
SA-240	..	405	12Cr-Al	60000	..	15000	15000	14700	14400	13950	13400	13000
SA-240	..	410	13Cr	65000	..	16250	15600	15100	14600	14150	13850	13700
SA-240	..	410S	13Cr	60000	..	15000	14450	14000	13500	13100	12850	12700
SA-240	..	430A	15Cr	65000	..	16250	16250	15200	14500	14000	13550	13250
SA-240	..	430B	17Cr	65000	..	16250	16250	15200	14500	14000	13550	13250
PIPES & TUBES												
Seamless												
SA-213	..	TP304L	18Cr-8Ni	70000	(1)	17500	17000	16000	15000	14000	13000	12500
SA-213	..	TP304L	18Cr-8Ni	70000	..	17500	15300	13100	11000	9700	9000	8750
SA-213	..	TP316L	18Cr-12Ni-2Mo	70000	(1)	17500	17500	15800	14750	14000	13600	13450
SA-213	..	TP316L	18Cr-12Ni-2Mo	70000	..	17500	16250	14500	12000	11000	10150	9800
SA-312	..	TP304L	18Cr-8Ni	70000	(1)	17500	17000	16000	15000	14000	13000	12500
SA-312	..	TP304L	18Cr-8Ni	70000	..	17500	15300	13100	11000	9700	9000	8750
SA-312	..	TP316L	18Cr-12Ni-2Mo	70000	(1)	17500	17500	15800	14750	14000	13600	13450
SA-312	..	TP316L	18Cr-12Ni-2Mo	70000	..	17500	16250	14500	12000	11000	10150	9800
Welded												
SA-249	..	TP304L	18Cr-8Ni	70000	(1)(4)	14900	14500	13600	12750	11900	11050	10600
SA-249	..	TP304L	18Cr-8Ni	70000	(4)	14900	13000	11150	9350	8250	7650	7450
SA-249	..	TP316L	18Cr-12Ni-2Mo	70000	(1)(4)	14900	14900	13450	12550	11900	11600	11400
SA-249	..	TP316L	18Cr-12Ni-2Mo	70000	(4)	14900	13800	12300	10200	9350	8650	8350
SA-249	..	TP309	23Cr-13Ni	75000	(4)(10)	16000	16000	14750	14200	14100	14050	14000
SA-312	..	TP304L	18Cr-8Ni	70000	(1)(4)	14900	14500	13600	12750	11900	11050	10600
SA-312	..	TP304L	18Cr-8Ni	70000	(4)	14900	13000	11150	9350	8250	7650	7450
SA-312	..	TP316L	18Cr-12Ni-2Mo	70000	(1)(4)	14900	14900	13450	12550	11900	11600	11400
SA-312	..	TP316L	18Cr-12Ni-2Mo	70000	(4)	14900	13800	12300	10200	9350	8650	8350
BOLTING												
SA-193	B8D	348	18Cr-10Ni-Cb	75000	(5)(7)	15000	15000	13600	12650	12200	11900	11850

MATERIALS AND STRESS VALUES TO BE ADDED TO

Material and Specification Number	Condition	Size, in.	Specified Minimum Tensile Strength Psi	Yield Strength Psi	For Metal Temperatures: 100	150	200	250	300	350	400
SB-171	Annealed	2 and under	50000	20000	12500	12500	12000	11200	10500	7500	2000
Leaded Muntz Metal	Annealed	Over 2 to 3.5	45000	15000	10000	10000	10000	10000	9000	7500	2000
	Annealed	Over 3.5 to 5	40000	12000	8000	8000	8000	8000	8000	7500	2000
Naval Brass	Annealed	3 and under	50000	20000	12500	12500	12000	11200	10500	7500	2000
	Annealed	Over 3 to 5	50000	18000	12000	12000	12000	11200	10500	7500	2000
70-30 Copper-Nickel	Annealed	2.5 and under	50000	20000	12500	12200	11900	11600	11300	11000	10800
	Annealed	Over 2.5 to 5	45000	18000	11200	10800	10500	10200	9900	9700	9500
Aluminum Bronze D	Annealed	2 and under	70000	30000	17500	17500	16800	16000	15500	15000	14500
	Annealed	Over 2 to 5	65000	28000	16200	16200	15600	15000	14500	14000	13500
Aluminum Bronze E	Annealed	2 and under	90000	36000	22500	22500	21000	19500	18000	16500	15000
	Annealed	Over 2 to 3.5	85000	33000	21200	21200	19800	18400	17000	15600	14300
	Annealed	Over 3.5 to 5	80000	30000	20000	20000	18700	17400	16100	14800	13600
Copper-Nickel, 90-10	Annealed	2.5 and under	40000	15000	10000	10000	9800	9500	9300	9000	8700

TO TABLE UHA-23

For Metal Temperatures Not Exceeding Deg F																	Material and Specification Number	Grade
700	750	800	850	900	950	1000	1050	1100	1150	1200	1250	1300	1350	1400	1450	1500		
																	PLATE STEELS	
14800	14700	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	SA-240	302
10800	10400	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	SA-240	302
14800	14700	14550	14300	14000	13400	12500	10000	7500	5750	4500	3250	2450	1800	1400	1000	750	SA-240	304
10800	10400	10000	9700	9400	9100	8800	8500	7500	5750	4500	3250	2450	1800	1400	1000	750	SA-240	304
12000	11500	11000	...	...	...	...	...	...	...	...	...	...	...	...	...	...	SA-240	304L
8500	8300	8100	...	...	...	...	...	...	...	...	...	...	...	...	...	...	SA-240	304L
16400	16200	15700	14900	13800	12500	10500	8500	6500	5000	3800	2900	2300	1750	1300	900	750	SA-240	309S
16600	16250	15700	14900	13800	12500	11000	9750	8500	7250	6000	4750	3500	2350	1600	1100	750	SA-240	310S
16600	16250	15700	14900	13800	12500	11000	7100	5000	3600	2500	1450	750	450	350	250	200	SA-240	310S
17000	16900	16750	16500	16000	15100	14000	12200	10400	8500	6800	5300	4000	3000	2350	1850	1500	SA-240	316
13250	13000	12700	12250	...	...	...	...	...	...	...	...	...	...	...	...	...	SA-240	316L
9450	9100	8800	8500	...	...	...	...	...	...	...	...	...	...	...	...	...	SA-240	316L
17000	16900	16750	16500	16000	15100	14000	12200	10400	8500	6800	5300	4000	3000	2350	1850	1500	SA-240	317
14800	14700	14450	14300	14100	13850	13500	13100	12500	8000	5000	3600	2700	2000	1550	1200	1000	SA-240	321
14800	14700	14450	14300	14100	13850	13500	13100	12500	8000	5000	3600	2700	2000	1550	1200	1000	SA-240	347
14800	14700	14550	14300	14100	13850	13500	13100	12500	8000	5000	3600	2700	2000	1550	1200	1000	SA-240	348
12450	11800	11000	10100	9100	8000	4000	...	...	...	...	...	...	...	...	...	...	SA-240	405
13400	13100	12750	12100	11000	8800	6400	4400	2900	1750	1000	...	...	...	...	...	...	SA-240	410
12500	12250	11950	11600	11000	8800	6400	4400	2900	1750	1000	...	...	...	...	...	...	SA-240	410S
12900	12500	12050	11500	10800	9200	6500	4500	3200	2400	1750	...	...	...	...	...	...	SA-240	430A
12900	12500	12050	11500	10800	9200	6500	4500	3200	2400	1750	...	...	...	...	...	...	SA-240	430B
																	PIPES & TUBES	
																	Seamless	
12000	11500	11000	...														SA-213	TP304L
8500	8300	8100	...														SA-213	TP304L
13250	13000	12700	12250														SA-213	TP316L
9450	9100	8800	8500														SA-213	TP316L
12000	11500	11000	...														SA-312	TP304L
8500	8300	8100	...														SA-312	TP304L
13250	13000	12700	12250														SA-312	TP316L
9450	9100	8800	8500														SA-312	TP316L
																	Welded	
10200	9800	9350	...														SA-249	TP304L
7200	7050	6900	...														SA-249	TP304L
11250	11050	10800	10400														SA-249	TP316L
8050	7750	7500	7200														SA-249	TP316L
13950	13800	13350	12700	11700	10600	8900	7200	5500	4250	3250	2450	1950	1500	1100	750	650	SA-249	TP309
10200	9800	9350	...														SA-312	TP304L
7200	7050	6900	...														SA-312	TP304L
11250	11050	10800	10400														SA-312	TP316L
8050	7750	7500	7200														SA-312	TP316L
																	BOLTING	
11800	11750	11650	11450	11300	11100	10800	10500	10000	8000	5000	3600	2700	2000	1550	1200	1000	SA-193	B8D

TABLE UNF-23

Not Exceeding Deg F						
450	500	550	600	650	700	
...	...	...	...	...	...	
...	...	...	...	...	...	
...	...	...	...	...	...	
...	...	...	...	...	...	
...	...	...	...	...	...	
10600	10400	10200	10000	9800	9700	
9400	9300	9200	9100	9000	8900	
12000	10000					
2000	10000					
13500	12000	10500	9000	7500	6000	
12900	11500	10100	8700	7400	6000	
12300	11000	9800	8500	7300	6000	
8300	8000	7000	6000	...	...	

PAR. UW-51(f) Revise Footnote 1 to read:

[1]Note: A test radiograph shall be made under substantially identical conditions as will be present on production radiography. Penetrameters shall be placed on both the radiation side and the film side, sufficiently staggered to obtain separate images. Each penetrameter should be provided with a marker which will show clearly on the film and which will indicate the side of the joint on which it is located: *f* for the film side and *s* for the radiation side. The smallest hole shall be distinguishable on both the *f* and *s* penetrameters. The difference of penetrameter images indicates degree of distortion.

APPENDIX IV Porosity Charts Revise present Porosity Charts to eliminate the isometric (end) views.

TABLE UCS-23 Revise and add new materials and stress values as noted in the accompanying table.

TABLE UHA-23 Add the accompanying stress values.

TABLE UNF-23 Under Copper and Copper alloys, delete the allowable stress values given for Naval Brass to SB-171, Tube Plates; Muntz Metal to SB-171, Tube Plates; Copper-Nickel, 70-30 to SB-171, Tube Plates; Aluminum Bronze to SB-171, Tube Plates. Add the accompanying stress values for SB-171 materials.

Current Engineering Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

A. R. Hard, *left*, inspects Plessis-Gassot substation in France

All barriers down as East and West discuss: Trends in power generation, long-distance, high-power transmission, and use of high-voltage d-c for power transmission

1958 CIGRE in Paris Surveys Trends in Power Generation,

In an atmosphere of complete freedom of international exchange, on the technical level, between East and West and among all the countries attending, 1800 engineers gathered to participate in the seventeenth meeting of the International Conference on Large Electric Systems (CIGRE) in Paris, France, June 4–14, 1958.

From the start it was evident that the Russian engineers, in particular, were able and willing to speak freely with delegates from the United States, Great Britain, and elsewhere alone or together.

Among the major points made at the meeting was the fact that the various trends in power generation and the demand for energy have not resulted in a diminution in the need for long-distance, high-power transmission of energy. Great Britain showed that the transmission need would become even greater with nuclear power. The harnessing of more remote sources of power in other countries is on an ever-increasing scale, and extra-high-voltage power transmission over increasing distances has no foreseeable limit.

The use of high-voltage d-c power transmission is sufficiently accepted and proved to be considered on its technical and economic merits for any particular transmission project.

Extra-High-Voltage Development

Philip Sporn, Hon. Mem. ASME, president, American Electric Power Service, was chairman of the section on developments at extra-high voltage. In his opening address he stated that CIGRE had the advantage of providing the maximum international co-operation in this particular field with the minimum cost and effort by bringing together the leading experts from all parts of the world. "The electric load doubles every ten years, in most countries," he stated, and "many of us have seen three stages of doubling of the load. This is the driving force behind extra-high-voltage developments. Not many years ago I said, at this CIGRE conference, to some who doubted whether the extension of load would warrant the very-high-voltage developments that some countries were embarking upon: 'Go home and make a projection over the next 25 years—what we call in America crystal gazing—and if you put enough thought into it you will see what higher voltages you are going to need.' The seeds of saturation might possibly be there somewhere, but they are far from coming to fruition. Furthermore, extra-high-voltage development is not now the exclusive prerogative of a few countries, and its technology is vigorous and expanding."

The special reporter of this section, F. Cahen of France, said that the most important questions in extra-high-voltage development can be divided into three groups: The development of the utilization of extra-high voltages; corona and radio-interference problems; and questions relating to internal overvoltages.

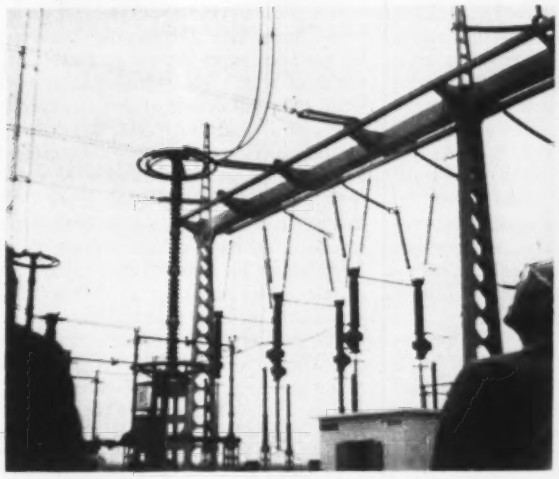
F. J. Lane of Great Britain, cautioned engineers not to presume too far on the essential nature of the service they provided. In many parts of the world, and in particular near large cities, the overhead line and accompanying radio interference are already obtruding too greatly on society. He mentioned several sites where as many as 20 overhead lines converged on a substation. "The economic incentive to use the overhead line as much as possible is, however, a most important factor, which is understood by the public as well as the engineer. At 275 kv the ratio of the cost of undergrounding to the cost of a double-circuit 550-mva overhead line may be of the order of 16 to 1. "Yet," continued Mr. Lane, "it still remains one of the engineer's responsibilities to minimize the obtrusiveness of overhead lines by restricting overvoltages, to reduce tower sizes; to give proper regard for the appearance of structures; to make the maximum use of any line route which interferes the least with the appearance of the countryside. Continued research on underground-cable insulation is essential so that transmission cost might one day be economically comparable with overhead-line costs."

Mr. Sporn intervened to say that he agreed with Mr. Lane's views. The limited space available, he added, in settled communities for transmission lines was obviously decreasing rapidly. In the United States the compulsory right-of-way which utility companies could obtain should be used with the greatest discretion, he noted.

Conversion of Existing Lines

The chief Russian delegate, Boris Lebe-

CIGRE conferees inspect suspended circuit breakers of minimum-BIL type rated 380 kv at the French substation located in Plessis-Gassot



Engineers and scientists at CIGRE often carried discussions beyond conference rooms. The group one sees here is still in search of conclusions on a Parisian street.

Demands for Energy on International Technical Level

dev, reported that at present there are lines in the USSR working at 420 kv and the Russians have made the discovery that it is feasible to change to 500 kv by using the same towers and substation structures generally, making radical changes only in the autotransformers. In this way they expect to achieve 40 per cent more power transmission. In fact, the whole of their 400-kv system now under construction as part of the high-voltage grid system in the European part of the USSR is to be changed over to 500 kv.

In the Asiatic part of the Soviet Union the power-transmission problem requires 2000 mw to be carried for a distance of at least 2000 kilometers. Here the economics of alternative methods of carrying energy have been considered. In some cases pipelines are being examined as an alternative to electrical transmission where oil and coal are involved. Future development of the electrical system at 600 kv with possible extension to 1000 kv d-c is also being contemplated.

Speakers from Britain and Sweden showed that nuclear generation would not decrease the need for transmission development. In Britain, the government's decision to locate nuclear plants far from the centers of population inevitably meant additional transmission capacity. Availability of cooling water will govern choice of future nuclear sites. In Sweden the location of hydroelectric resources in the extreme north of the country, and the fact that these stations would form ideal partners for nuclear plants, led to the same conclusion.

In considering the increase of working voltage on existing systems, an interesting report from France described how a two-circuit 225-kv line built ten years ago was converted to a single-circuit 380-kv line with bundle conductors with two conductors per phase. Delegates later visited the Paris end of the line.

In the discussion, it was suggested that the single-circuit character of the French line did not make the best utilization of the terrain. However, there is ample room for further overhead-transmission-line development in much of its territory.

A paper from Canada by J. W. Simpson and V. E. Ogorodnikov of the Hydro-Electric Power Commission of Ontario, described the conversion of 115-kv lines to operate first at 230 kv and later up to 262 kv. Mr. Casson of the British Central Electricity Generating Board said that there must have been considerable overdimensioning of the lines, when they were installed in 1953, to permit such conversion. J. H. Waghorne of the Electrical Research Department in Toronto agreed that the line was conservatively built.

Mr. Casson gave some interesting figures about the reasons behind the choice of 275 kv as the next voltage in the British grid system after over 20 years' operations with 132 kv. Converting a double-circuit 132-kv line to single circuit 275 kv would double the power-transmission, while a similar operation with a change of 275 kv to 380 kv would only increase transfer capacity 50 per cent. He said that unless it was possible to double the capacity it would be better to use a new line. He commented on a West German 380-kv design, in which the conductor for the ground wire was given the same dimension as that of each of the wires in a 4-conductor bundle, was justified for higher short-circuit acceptance, and in any case a heavy ground wire tends to reduce losses. A current of considerable magnitude flows in the ground wire under normal conditions, depending, of course, on the configuration of the line.

A subject touched on in this session and also in the generator session was that of the provision of reactive power. It was thought undesirable to cause reactive power requirements to be produced at the generators themselves. Mr. Lalander of the Swedish State Power Board expressed the view that it was too costly to transmit reactive power over great distances, and that capacitor banks should be used near the load centers to produce this power. In big stations synchronous condensers were preferred, and in Sweden they have decided to employ 100-mva machines of this type. The British have used 40-mva capacitors where the requirement for reactive power would be distributed over a large number of points.

Dr. Burgsdorf of the USSR added that when the first 400-kv lines in Russia were designed, the figure of three times the phase voltage was taken as representing the likely overvoltages. Further research has shown that with proper insulation levels 2.5 times the phase voltage can be used. Russian engineers stated that the serious effect of pollution on very short sections of their lines would be corrected by adding more insulation.

Corona and Radio Interference

On the question of corona and radio-interference problems, the United States announced that tests were to be made on lines operating up to 750 kv. The most common method of countering radio interference is the use of bundle conductors, reported two American papers.

W. S. Price stated that radio interference in the last ten years had received attention and was still one of the most complex problems transmission engineers had to face. A. R. Hard said that the use of twin or triple conductors implies severe mechanical problems because of the necessity for employing spacers. The results of studies on conductor vibration on an outdoor test span under an actual transmission line on the Bonneville power system were reported. The accompanying film contained slow-motion pictures of extra-high-voltage lines vibrating and twisting under snow-release conditions, simulated by the dropping of sand bags. Mr. Hard also gave a useful survey of every existing type of spacer. Continental practice has favored the employment of two or three types in each case, but no previous survey at CIGRE or elsewhere has given an impartial comparison between the 20 or 30 spacer types now evolved in Russia, the Western European countries, and the U. S.

While Russian engineers acknowledged the desirability of limiting radio interference and had evolved the three-conductor bundle mainly for this purpose, they thought that basically this was not as important as the corona losses which might effect the economic working of the line at extra-high voltage above 500 kv. Most of their lines pass over extremely sparsely populated country, and radio interference is regarded as secondary.

The German engineers stated that their 4-bundle 380-kv lines had given extremely low radio-interference levels. British reports on twin-bundle 275-kv lines showed acceptable interference.

Generators, Transformers, Circuit Breakers, Cables

There were many detailed discussions in the sections devoted to generators, transformers, circuit breakers, cables, and so forth. In the transformer field, A. Lang of AEG in Germany, reported that a d-c controlled reactor used as a transductor was advocated for high-voltage power-transmission tap-changer application. The advantage would be elimination of contacts since it is this feature of most tap changers which gives rise to most of the maintenance problems. However, the cost is much greater.

On transformer noise, E. C. Wentz of Westinghouse stated that most of the larger transformers are located on generating stations and on bulk-supply transformer stations, where the residential areas are usually some distance away.

There was seen to be a growing tendency to use autotransformers for the interconnection of the new high-voltage system with the remainder of the network. W. Casson and G. B. Harper of Great Britain comprehensively surveyed comparative designs of transformers.

There was a reaction against the proposals to give very large transformers overvoltage tests and impulse tests on site after erection, which was considered unnecessary as well as very costly.

The behavior of large transformers under short-circuit conditions needs further research, particularly on mechanical properties of the copper employed in the windings, which are often altered by the presence of very small impurities in the metal, and sometimes cause recrystallization.

Substations

For the first time at a CIGRE Conference, there were papers from the People's Republic of China. These dealt with the prefabrication of concrete elements to make up high-voltage substations in which the minimum quantity of steel was required for lattice work or reinforcing, and stressed strict economy.

R. S. Orchard, a British engineer, suggested that CIGRE could perform a valuable service if it defined more exactly the difference between transmission and distribution, particularly in regard to substation design. The approach to long-term planning differs widely in these two spheres of power engineering.

In a number of cases the papers and discussions indicated clearly the tendency toward bringing higher and higher voltages, in most cases by means of cables, right into the center of towns and industrial areas.

Submarine Cables

The cable session was notable for the general acceptance of the need for d-c cables for submarine use. The trial installation of high-voltage d-c power transmission between Kashira and Moscow, the successful functioning over four years of the Sweden-Gotland scheme, and the decision to lay a d-c cable link across the Channel between England and France, and a number of other schemes involving submarine cables were described. Perhaps the most interesting was a proposal from Italy for an 82-mile cable crossing the Adriatic Sea and linking the Yugoslavian water-power resources with the areas in the south of Italy where there is a power shortage.

There is still room for argument as to the best form of submarine cable, whether for a-c or d-c use. For d-c, the choice so far has been paper-impregnated cable of the solid type. Mr. Gorodetzki of the USSR gave full details of service experience with a ±200-kv d-c cable and experimental experience with a ±400-kv cable, and in both cases comparisons were made between solid and oil-filled types. A British paper advocated the use of plastic-insulated cables for high-voltage d-c. Experiments have shown that extruded-plastic cables working at 200 kv to ground are perfectly practicable.

The growing extent of a-c submarine-cable links was revealed. A Japanese paper described how a submarine plow was used to cut a channel in the sea bottom. Methods to accurately locate submarine cables after laying and the problems of corrosion of armoring were taken up in discussion.

Another controversial point was whether continuous manufacture of cable of one length is as great an advantage as some British manufacturers claim, particularly, since flexible joints are now thoroughly reliable.

For the Channel Cable project, involving a 25-mile transfer of 160-mw power at ±200 kv d-c, two single-core solid paper-insulated cables are to be laid, with a 0.525-sq-in. conductor. In each cable there will be a joint in mid-Channel.

The claims of gas-filled cables for high-voltage a-c were advanced. In the discussion it was seen that there is still no definite final choice between: Three-phase flat cable with fluid oil, solid paper-impregnated cable (for d-c), and gas pressure preimpregnated cable. Plastic cable is now entering the field.

Plessis-Gassot Substation

Delegates visited the Plessis-Gassot substation, the Paris termination of the French 380-kv line from Gennissiat, where they saw the suspended-type 380-kv, 13,000-mva minimum oil breakers made by Ateliers de Constructions Electriques de Delle of France. This novel form of construction resulted in notable economy in foundation work and connection equipment. There was an experimental air-blast breaker made by the same company, providing a breaking capacity of 25,000 kva, and suitable for 525-kv normal voltage.

CIGRE 1958 again demonstrated the value of international co-operation in the technical field. It was particularly interesting to find American and Russian engineers continuing their discussion informally outside the conference room.

U. S. Government and Industry Plans for Atomic Energy Exhibits—Commercial and Technical—at Geneva, September 1–14, Announced

THE United States Atomic Energy Commission, under a contract with the Atomic Industrial Forum, Inc., of New York City to design and operate, will participate along with 49 U. S. industrial companies in the Second International Exhibition of the Peaceful Uses of Atomic Energy—a commercial exhibition—in Geneva, Switzerland, from September 1 to 14, 1958.

The commercial exhibition will be held in the Palais des Expositions in downtown Geneva at the same time that the United Nations' Second International Conference on the Peaceful Uses of Atomic Energy, featuring the official presentation of technical papers and technical exhibits by many nations, is in progress at Geneva's Palais des Nations. The commercial exhibition is a display by industrial manufacturers throughout the world of atomic energy equipment, components, products, and services available on the open markets to those who wish to buy.

The United States portion of the commercial exhibition will occupy approximately 32,000 sq ft in the recently enlarged Palais des Expositions. The focal point and symbol of the American section of the exhibition will be a full-scale model of the core of an atomic power plant capable of producing 150,000 kw of electric power. Surrounding the model core will be a rotunda containing an information center and displays by the 49 industrial companies participating through which the over-all story of the U. S. atomic industry will be told.

High lights of the American section include two "live" atomic reactors of the research and training type; a completely equipped, mobile radioisotope laboratory, a film theater where a continuous program of atomic energy films from both industry and government will be shown; a display of U. S. technical publications and journals; and a newly designed "master slave" robot capable of performing functions with human precision in laboratory areas too radioactive for humans to enter.

U. S. Technical Program

The United States part in the technical conference is being carried out jointly by the Department of State and the Atomic Energy Commission. This year there will be 61 nations and nine specialized agencies of the UN participating and 21 will conduct technical exhibits and demonstrations in the building specially constructed for the purpose on the grounds of the Palais des Nations.

The U. S. presentation will include:

▶ A 50-part general technical exhibit on the peaceful uses of atomic energy, highlighted by two operating research reactors and many research demonstrations and experiments.

▶ More than 700 technical papers dealing with peaceful aspects of the atomic energy program.

▶ A unique motion picture facility comprising 45 new technical films, of which 17 will be made available to the United Nations for showing at the Palais des Nations, and the remaining 28 shorter films will be shown as part of the U. S. exhibit at the Palais des Expositions.

▶ A technical information center where U. S. books and periodicals will be displayed.

The technical exhibit, including the controlled thermonuclear reaction exhibition, the fusion exhibit showing principal research paths taken in four U. S. Laboratories, and the physical and life sciences exhibits, will complement the U. S. technical papers on the program.

Technical Papers

At the invitation of AEC industrial nuclear scientists and engineers, staff members of hospitals and private educational and scientific institutions have prepared 1553 abstracts of technical papers proposed for presentation at the Conference. More than 700 papers will be submitted to the UN, which will be accepted for inclusion in the UN proceedings. Approximately 160 of these will be recommended for oral presentation at the Conference.

1959 Nuclear Congress Plans Are Shaping Up

PRELIMINARY plans for the Fifth Nuclear Congress to be held in Cleveland, Ohio, April 5–10, 1959, were announced recently by the Engineers Joint Council. At the same time engineers and scientists who would like to present technical papers at the Congress are invited to submit outlines before October 1, 1958.

The 1959 Nuclear Congress is sponsored by 29 engineering and scientific societies, including The American Society of Mechanical Engineers, and EJC acts as coordinator.

As in the past the Congress will be composed of four parts: The fifth Nuclear Engineering and Science Conference, seventh Hot Laboratories and Equipment Conference, seventh Atomic Energy Management Conference, and the Atomfair, showcase of the latest in nuclear equipment. The Congress will be held at the Cleveland Auditorium and will be dedicated to the theme, "For Mankind's Progress."

Clarke Williams of Brookhaven National Laboratory, chairman, Nuclear Engineering and Science Conference announced that papers will be considered for inclusion in the 1959 program if summaries are submitted before Oct. 1, 1958. He stated that prospective authors should submit 300 to 500-word summaries of proposed papers to the secretary of any one of the sponsoring societies. A list of sponsoring groups is available from EJC, 29 West 39th Street, New York 18, N. Y.

Mr. Williams stated that papers selected would be those presenting the most recent and outstanding developments in the nuclear field. Topics in the past have included reactor design, power plants, radiation techniques, instrumentation, shielding, waste disposal, and related items.

For additional information on the Congress write to T. A. Marshall, Jr., Congress Manager, or L. K. Wheelock, Assistant Manager, c/o EJC, 29 West 39th Street, New York 18, N. Y.

Nuclear Congress Papers—Hot Laboratories and Equipment

ABSTRACTS for papers to be presented at the Seventh Conference on Hot Laboratories and Equipment to be held in Cleveland, Ohio, April, 1959, are due Sept. 15, 1958, and should be sent to program chairman: L. G. Stang, Jr., Brookhaven National Laboratory, Upton, N. Y. Deadline for papers will be announced later. Papers are invited on all phases of hot laboratories and equipment for handling radioactive material including design, construction, operation, maintenance, decontamination, remodelling, shielding calculations, costs, and so on.

Left to right: W. Prager, secretary of Applied Mechanics Division and chairman of Organizing Committee of Congress; E. Reissner, lecturer; W. F. Ryan, ASME past-president; Commander W. T. Alford, Executive Officer, Newport Navy Base; W. Ramberg, chairman of Applied Mechanics Division; and A. Wahl, member.

Applied Mechanics Reviews display at Congress of Applied Mechanics, Providence, R. I., June, 1958. *Left to right:* Stephen Juhasz, executive editor AMR; Philip Aris, Yale; W. Soroka, UCLA; William Prager, Brown; Gabriel Horvay, General Electric; J. M. Crowley, ONR; Harold Liebowitz, ONR; Martin Goland, editor AMR; N. J. Hoff, Stanford, and Miklos Hetenyi, Northwestern.

The Third U. S. National Congress of Applied Mechanics at Brown University

ALMOST 500 engineers and scientists attended the Third U. S. National Congress of Applied Mechanics at Brown University, June 11–14. All appeared to enjoy themselves and to profit professionally. Industrial, educational, and governmental organizations were represented on the program and in the lively discussion of the 100 papers presented.

The sponsoring group for national congresses is the U. S. National Committee on Theoretical and Applied Mechanics which is a joint committee of the American Physical Society, the American Mathematical Society, the Institute of the Aeronautical Sciences, the Society for Experimental Stress Analysis, and the relevant Founder Societies: ASCE, ASME, AIChE. Twenty-eight universities and industrial corporations contributed toward the financial support of the Congress and the Proceedings which will appear at the end of this year with the full text of all papers. The Department of Defense through the Office of Naval Research, Office of Ordnance Research, and Office of Scientific Research defrayed editorial costs of the Proceedings.

Four invited general lectures were the technical high lights of the Congress. Prof. N. J. Hoff, Mem. ASME, spoke on creep buckling; Dr. H. L. Dryden, Fellow ASME, on boundary-layer flow; Dr. M. A. Biot on thermodynamics and mechanics; and Prof. E. Reissner on rotationally symmetric shell problems. Their comments provided both a summarizing look backward and a research look forward and so were a source of stimulation. The remaining technical papers covered dynamics, vibrations, elastic waves, elasticity, structures, plasticity, viscoelasticity, fracture, fluid flow, aerodynamics, and heat transfer. The level of the papers and of the discussion was high. Chairmen of the 28 technical sessions in the four days kept to the time schedule so that there was no conflict with the general lectures and Congress members could shift among the simultaneous sessions as their interests dictated.

The more popular research fields today continue to show the influence of the problems encountered in direct engineering application. Dynamics is taking an increasing share of attention and plates and shells show the worries of the missile and turbine fields. Fluid mechanics, aerodynamics, and heat-transfer sessions were active but the number of papers were appreciably fewer than the importance of these subjects warrants. Much attention was devoted to means of correcting the unbalance in the future.

The social high light of this predominantly technical meeting was the cocktail party and banquet held at the Officers' Club of the U. S. Naval Base, Newport, R. I. Prof. William Prager, chairman of the Organizing Committee, was toastmaster and welcomed all on behalf of the Committee which includes D. C. Drucker, secretary; E. H. Lee, treasurer; and R. M. Haythornthwaite, chairman of the Editorial Committee. Following greetings by Commander W. T. Alford, Executive Officer of the Base, Dr. Barnaby C. Keeney, President of Brown University, and Dr. W. F. Ryan, past-president and Hon. Mem. ASME, Dr. Wallace R. Brode, Science Adviser to the Department of State, spoke on "International Science." He placed much emphasis on the role engineers and scientists play in international relations. Other social activities arranged by Professors E. T. Onat and R. T. Shield included informal coffee hours and a women's program under the direction of Mrs. William Prager. The Editorial Committee was entertained by Prof. R. M. Haythornthwaite prior to a session which drew up recommendations for future congresses.

Professor Hoff, chairman of the U. S. National Committee, announced that the next Congress will be held June, 1962, at the University of California in Berkeley.

The ASME Applied Mechanics Division took the opportunity to hold a dinner meeting of the Executive Committee and Advisory Board and a luncheon meeting of the Executive Committee. Dr. Walter Ramberg, Division chairman, presided.

PEOPLE

Honors and Awards. DONALD A. QUARLES, Deputy Secretary of Defense, has been named an honorary member of the American Institute of Electrical Engineers. The honor was conferred at the Institute's summer general meeting in Buffalo, N. Y.

LOUIS POLK, a director and Mem. ASME, director and group executive vice-president, Bendix Aviation Corporation, was awarded an honorary DS degree by Miami University, Oxford, Ohio. Mr. Polk, currently chairman of the ASME Board on Codes and Standards, was honored for his "contributions in advancing the arts of engineering dimensional control and metrology."

L. AUSTIN WRIGHT, Mem. ASME, upon his retirement, after 20 years of service, as General Secretary of the Engineering Institute of Canada was elected to honorary membership in the Institute. EIC honored him at its annual meeting in Quebec City, P. Q., Canada. Among those also honored at the meeting was RICHARD E. HEARTZ, Hon. Mem. ASME. Mr. Heartz, president and director, The Shawinigan Engineering Company, Ltd., Montreal, P. Q., Canada, received the Julian C. Smith Medal.

JAMES HARLOW, Mem. ASME, chief, mechanical engineering department, Philadelphia (Pa.) Electric Company, was among 13 engineers elected Fellows of the AIEE. He was cited "for notable contributions to improvement in economy of electric-power generation."

MABEL ROCKWELL, project engineer, Westinghouse Electric Corporation, Sunnyvale, Calif., is the recipient of the 1958 Annual Award presented by the Society of Women Engineers. The award was conferred at the society's national convention in Pittsburgh, Pa.

HERBERT J. BALL, Mem. ASME, and former professor of textile engineering, Lowell Institute of Technology, has been elected to honorary membership in ASTM.

RUSSELL HOWARD HEILMAN, Mem. ASME, senior industrial fellow, Mellon Institute of Industrial Research, Pittsburgh, Pa., was presented with an ASTM Award of Merit. He was cited in recognition of important, outstanding contributions to the work of ASTM Committee C-16 on thermal insulating materials.

MANOEL F. BEHAR, Mem. ASME, retired editor, *Instruments*, was awarded the Pratt Institute Alumni Medal in recognition of his many years of support and his efforts in behalf of the Alumni of the Institute.

LILLIAN M. GILBRETH, Hon. Mem. ASME, was honored on her 80th birthday at a banquet given by the New Jersey and New York Sections of the Society of Women Engineers. Dr. Gilbreth, who is an honorary member of EIC, was in Quebec recently to attend the 72nd annual meeting of the Institute.

SANFORD L. CLUETT, Mem. ASME, vice-president, Cluett, Peabody and Company, Inc., was the first man to receive an honorary degree from Russell Sage College. Mr. Cluett is the inventor of the Sanforized process of shrinking cloth and recently developed a stretchable paper.

New Officers. K. F. TUPPER, Ewbank and Partners, Ltd., Toronto, Canada, was inducted into office as president of the Engineering Institute of Canada for the year 1958–1959.

SIR R. OWEN JONES, Air Marshall, has been elected to succeed SIR GEORGE NELSON as president of the Institution of Mechanical Engineers.

RENARO CONTINI, engineer and senior research scientist, College of Engineering, New York University, has been elected president of the Human Factors Society of America, Inc. The society, founded in September, 1957, is concerned with "man-machine problems."

Campus Data. NORMAN N. BARISH, Mem. ASME, chairman of the industrial and management engineering department, College of Engineering, New York University, has been named associate dean.

ROBERT C. BOYER, Assoc. Mem. ASME, Rockford, Ill., has been named a fellow in instrumentation by the Foundation for Instrumentation Education and Research (FIER). The fellowship will enable the recipient to study for his MS degree in the field of control technology at Purdue University under the direction of RUFUS OLDENBURGER, Mem. ASME. A second fellowship went to LESTER M. SASLOW, Assoc. Mem. ASME, a graduate of Polytechnic Institute of Brooklyn. He will prepare his master's thesis at Massachusetts Institute of Technology under J. LOWEN SHEARER, Mem. ASME.

JOSEPH H. KEENAN, Fellow ASME, has been named head of the department of mechanical engineering at the Massachusetts Institute of Technology. He succeeds JACOB P. DEN HARTOG, Fellow ASME, who will devote his full time to teaching and research. Professor Den Hartog, last November, was the first American ever invited to give the Thomas Hawksley Lecture in London.

L. Austin Wright, *center*, Mem. ASME, who retired as General Secretary of the Engineering Institute of Canada, June 1, is shown at EIC Annual Meeting in Quebec City, P. Q., Canada, with C. M. Anson, *left*, past-president EIC, and K. F. Tupper, president-elect. Dr. Wright will continue to serve the Institute in a consulting capacity.

Notes on Society Activities and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

1958 ASME SEMI-ANNUAL MEETING

GOOD WEATHER, an unusually interesting group of inspection trips, and a lively social program, as well as a broad technical program all contributed to the success of the Semi-Annual Meeting, Detroit, Mich., June 15–19, 1958, of The American Society of Mechanical Engineers. More than 1150 participated in the meeting and took a look at some of the engineering accomplishments of the Detroit region. The city is undergoing a major face-lifting with a new ultramodern waterfront Civic Center, and the miles of expressways which speed traffic to and from the suburbs and through the city. This was the first time in 12 years that Detroit had been host to a Semi-Annual Meeting, as noted by Glen H. Howell, chairman of the Detroit Section at the opening President's Luncheon.

Luncheons and Banquet

President's Luncheon

W. F. Ryan, past-president and Hon. Mem. ASME, presided at the luncheon on Monday, where ASME President James N. Landis spoke briefly on the "vitality of our organization," after an invocation by The Very Reverend C. J. Steiner, S.J., president of the University of Detroit.

"Credit for this fine state of affairs," President Landis said, belongs to the officers recently selected by the Nominating Committee. The Vice-Presidents in particular deserve appreciation for the job they perform. They are the Society's workhorses, and the amount of travel required by their position is so great, particularly in the West, that the Regional Delegates Conference considered splitting Region VII. After thorough discussion they felt that the unity of the area was more important since the Vice-Presidents had indicated that they did not mind traveling.

Mrs. Robert W. Worley, National President of the Women's Auxiliary to the ASME, spoke of the growth of that organization from an annually appointed committee to its present status and of the several scholarships administered by the group.

The balance of the President's Luncheon, except for the presentation of a 10-gallon hat and a certificate from Governor Daniels of Texas making ASME President Landis an honorary citizen of Texas, was devoted to an address by W. E. Reaser, assistant secretary of ASME.

Mr. Reaser announced that on June 14, the Council had taken action which elevated the former Education Committee to the status of a new Board on Education. This had been the result of a succession of events sparked by a March, 1957, meeting of the heads of mechanical-engineering departments in the schools of Region VI. Other regional meetings in which 105 of 150 invited educators participated, made it apparent, said Mr. Reaser, the teacher-adminstrators cherished the opportunity to engage in conclaves of such import to them. The minutes that serve as a record of the purposefulness of this nation-wide Society activity attest to the thoroughness with which the conferees examined the issues. In general, day-long periods were devoted to critical analyses of the suggested-agenda topics, as well as of other matters which naturally arose among those whose common purpose is engineering education. These reflected the insistent demand from the educators, Mr. Reaser pointed out, that there may be made available more "well-paved avenues" within the Society by which to exchange ideas and opinions, both among themselves and with others who consider engineering education a segment of the mechanical engineering profession worthy of their most avid attention. "The Board on Education," he concluded "should be instructed to implement at the earliest moment the purposes implicit in the establishment of this new board."

Production Engineering—AIEE—Management Luncheon

Ford H. McBerty, chairman of the ASME Production Engineering Division presided at the luncheon on Tuesday. After an invocation by G. Merrill Lenox, D.D., executive director of the Detroit and Michigan Council of Churches, Harvey E. Bumgardner, Mem. ASME, assistant to the president of The Detroit Edison Company, introduced the

Left, **ASME members see the "Firebird I," experimental gas-turbine car, on the inspection trip to General Motors Technical Center;** ***top center,*** **Management Luncheon speaker Kenneth Kramer, managing editor,** ***Business Week;*** ***top right,*** **Tuesday luncheon speaker James C. Zeder, vice-president of engineering and special assistant to president, Chrysler Corporation;** ***bottom right,*** **Banquet speaker K. T. Keller, Fellow ASME, formerly president and chairman of the board, Chrysler Corporation. Seated at his right is Walker L. Cisler, Fellow ASME, president, The Detroit Edison Company.**

speaker James. C. Zeder, vice-president of engineering and special adviser to the president of the Chrysler Corporation. Mr. Zeder spoke on "Educating Today's Engineers for Tomorrow's Challenges." Portions of his address will appear in a forthcoming issue of MECHANICAL ENGINEERING.

Management—AIIE Luncheon

Hugh Bogle, member of the Executive Committee of the ASME Management Division, presided at the luncheon on Wednesday. The invocation was delivered by The Reverend Andrew F. Rauth, minister of the Grosse Pointe Woods Presbyterian Church. Kenneth Kramer, managing editor of *Business Week*, spoke on "Our Changing Economy—Management's Responsibility." The opening portion of his talk was devoted to an assessment of the severity of the present depression and of the probable length. Only four depressions, he stated, have lasted more than 24 months, and only one of those was since 1875. Based on that experience it is likely that the recession will end by August, 1958, and odds are 2 to 1 that it will be over by year's end, and 10 to 1 that it will end by August, 1959.

Consumer products, which are off only 2 per cent, are faring better than industrials which are off 3 per cent. Housing starts are 6 per cent better than in April, 1958. Capital investment is still declining, but inventory reduction is being curtailed also.

What do we do now? Mr. Kramer stated that: (*a*) We should resume buying to replenish inventories, (*b*) hedge against inflation, (*c*) push sales but maintain or reduce prices, (*d*) invest capital now, spending about 20 per cent for modernization, (*e*) keep up research and development. The gross national product is expected to be about $8 billion for 1958, or about $1 billion greater than for 1957.

Mr. Kramer predicted that new highs were ahead for production, employment, and sales, once the recession has cleared. He expects foreign trade to triple in the near future, and the industrial or producer-goods portion to increase, with a decrease in the consumer goods portion. We can take comfort, he stated, in the fact that the economy's built-in preventives have helped reduce the severity of the present depression.

Banquet

Walker L. Cisler, Fellow ASME, president, The Detroit Edison Company was toastmaster at the Banquet, Dr. E. Shurley Johnson, minister of Central Methodist Church, delivered the invocation. K. T. Keller, Fellow ASME, formerly president and chairman of the board of the Chrysler Corporation, spoke on "Fifty Years Association With Engineers."

Engineers are trained not to be fooled by minor or half truths, Mr. Keller stated. This country's greatness has come largely from the work our engineers have done, but engineers should not forget that their work is judged by its usefulness to mankind. Those things which are not useful fall by the wayside.

Speaking of the current emphasis on space travel, Mr. Keller said that if we do find any people on Mars, he hoped we would bring some back and see what we could learn from them rather than trying to impose our ideas on them. Engineering talents are one thing that we can be sane and objective about, he said.

He suggested that an advisory committee for the Military composed of the presidents of the engineering societies would be a good means of liaison with that group. These society presidents could appoint ad hoc committees for specific purposes. Mr. Keller, a member of the Army scientific advisory panel, noted that one of the things his experience has taught him is, although we are short of engineers, we have not learned to make the most effective use of their talents. Engineers and scientists should not take over military problems. There is no substitute for getting into the physical presence of a problem. That clears it up quickly, and those who live with their work know it best. He felt that the top rank devoted to the maintenance of mechanized equipment in an age of mechanized warfare ought to be higher than the present rank of Colonel given to that position. Our society can be kept going, he said, if we are willing to make some sacrifices to see that it is done.

Technical Program High Lights

A total of 102 technical papers was presented at the Semi-Annual Meeting, of which 74 were available at the meeting in pamphlet form. Some of the high lights from the technical sessions follow:

Management and Production Engineering. The ASME Management and Production Engineering Divisions, and the American Institute of Industrial Engineers joined to take a look at Russian automation and automation progress in the United States. The Russian observations were made by a trio of Ford, Westinghouse, and Bendix engineers at the expense of their companies in December, 1955. They found that on the whole the Russian plants they saw were not as productive as those in the U. S., but that the interest in automation appeared greater there, and manual-production machines were no longer being built where automated lines could be applied. They concluded that if the plans they saw were carried out, "By 1965 many of the production facilities will be comparable to ours, and by 1970 their production facilities and techniques may be superior to ours unless a new emphasis is placed on automated production in this country."

There has been progress not only in the development of the concept of automation and in the acceptance of the concept, but also in techniques involved in application, according to Lee D. Miller, associate editor of *Automation*, with probably the greatest potential importance being the acceptance the concept has gained and is gaining in job-lot industries and small companies which directly affect the majority of our people. A few of the recent installations include such widely different applications as roller-bearing production, concrete batching, automatic spot welding, and warehousing. Important techniques that have been developed have been the use of over-all systems approaches, standardization, use of building blocks, cross-breeding of ideas, and more pre-engineering.

The Management Division also considered the problems of engineer retention, the more efficient use of research scientists' time, and concepts of job assignment in project-type engineering.

Methods for the orderly and economic handling of engineering data, electronic-data-processing retrieval and storage of coded mechanical-engineering data, and a border-punched-card system for the same purpose were also presented.

The Production Engineering Division also contributed studies on machining, cutting, and grinding, and on the use of statistics in this field. The statistical studies were on the use of computers for on-line production control, and on minimizing waste in the strip cutting of paper, sheet metal, foil, or other roll stock.

Power. The Power Division, the American Society for Testing Materials, the Research Committee on High-Temperature Steam Generation, and the Metals Engineering Division presented a symposium on "Alloy Superheater and Reheater Tubing Operating at 1000 F and Above." Session Chairman A. C. Pasini in introducing the topic stated that it is "a moot question" whether we have moved "too far and too fast" in beginning an "uncharted course in the 1000 to 1100 F steam cycle." Since the first excessive creep with austenitic tubing, particularly Type 321, was discovered about two years ago, attempts have been made to find the cause and cure. There have been very few actual ruptures, failure being considered as creep in excess of 1 per cent in 50,000 hr; however, enough rupture failures have occurred to indicate that rupture would follow if creep were allowed to continue.

In attempting to run down the cause, it was discovered that grain size is an inadequate measure of high-temperature strength, and that high and low-carbon steels differ little. The failure is felt to be related to too low an annealing temperature and it has been found that the high-temperature-strength properties do improve as heat-treating temperatures are raised. Reannealing at 2000 to 2050 F is definitely beneficial.

This is true of postfabrication treatment and applies even after tubing has been in service for some time. One company has sought corrective measures for existing installations and had hoped to be able to apply reheat treatment in place, but has been unsuccessful to date. Single tubes have been given reheat treatment in the field, outside the boiler with a high-amperage low-voltage resistance method in which the tube itself serves as the resistance. Good uniform grain size has been obtained. A small special annealing furnace for heat-treating tubing in small quantities has also been developed.

Results obtained have definitely indicated that acceptance of a nominal anneal treatment was responsible for much of the tube failure, that higher annealing temperature gives higher strength, and that reannealing is definitely beneficial. It is believed that the new Type 321 H alloy will solve the problem and be adequate for new installations.

The engineering considerations for the

Detroit Edison Company's River Rouge Power Plant, which was visited on one of the inspection trips, were reviewed and the design of the record-breaking Allis Chalmers 321-mw cross-compound steam turbine being installed as a third unit was described. The control system for another large steam turbine, the General Electric Company's 225-mw double-extraction unit at Public Service's Linden, N. J., plant was also described.

The use of "second-law analysis" or "entropy-balance" methods were advocated under the title "availability balance" as a means of making a more accurate assessment of the losses in a power plant now that electronic computers are available for these more tedious types of analyses. The elimination of a complicated interstage control system by use of a modulator for each heater in a "K-F" open feedwater heating cycle, and elimination of turbine shutdowns from bearing failure by grounding—the result of an investigation of electrostatic shaft voltage on steam-turbine rotors—were among the operational topics presented. Developmental papers included description of General Electric's new low-pressure turbine-development facility, some of the results achieved with 5000 hr of operating a 2000-lb-per-hr pilot supercritical steam generator, investigations by Combustion Engineering of the performance of various components of pulverized-coal-transport systems.

Lubrication. The Lubrication Division sponsored a workshop on bearing lubrication, a digest of the 1957 literature on ball and roller bearings and gear lubrication. Papers were presented on fluid-film journal and thrust bearings, boundary-lubrication friction and wear, metal-working lubrication, automotive lubricants, a variational approach to lubrication problems, and the solution of the finite journal bearing, as well as the load capacity and attitude angle of gas-lubricated journal bearings. The complete report will appear in a forthcoming issue of MECHANICAL ENGINEERING.

Top left, student-prize winner, Mrs. Janet O'Brien of NYU, at the Enrico Fermi Atomic Power Plant with Christine Otis of Detroit Edison. *Top right,* a Gas Turbine Power session. *Bottom left,* symposium on high-temperature tubing. *Shown left to right:* ASME Members C. L. Clark, Timken; H. L. Solden, Public Service; Vice-Chairman P. H. Gravelle, Toledo Edison; Chairman A. C. Pasini, Detroit Edison; P. M. Brister, Babcock & Wilcox; J. L. Menson, Combustion Engineering; H. H. Hemenway, Foster Wheeler. *Bottom right,* Shih-Yuan Chen, Assoc. Mem. ASME, Republic Aviation, presents paper at a Heat Transfer Session. M. J. K. Newman, Mem. ASME, looks on and T. W. Jackson, Mem. ASME, takes notes.

Fuels. The special problems of diesel-engine wear when residual fuels are used, burner-maintenance problems with gaseous and liquid fuels, simplification of gas-fired heat processes, and a flame-sensing scanner for automatic boilers were among the topics of papers. It was also reported that the use of an IBM 705-computer to calculate and produce a monthly finished fuel analysis and fuel-consumption report which required approximately 42,000 calculations and transposition of 78,000 figures without error resulted in savings of about $700 a month for Commonwealth Edison Company after the cost of programming was written off.

Gas-Turbine Power. Possible configurations for an automotive gas-turbine unit, design and development of a supercharger for a marine pressure-fired boiler, smoke flow visualization of rotating-stall behavior, the development of practical hypotheses concerning the nature of flow between axial-compressor blades, and radiochemical techniques for the determination of erosion in turbojet-fuel nozzles were topics for this division.

Process Industries. In addition to cosponsoring sessions with the Management, Production Engineering, Materials Handling, and Instruments and Regulators Division, the Process Industries Division contributed papers on the use of Boolian algebra and logic in the design of special alarm circuitry for a process-steam analyzer and on the mathematical relationships for computer control systems.

Rubber and Plastics. A summary of the papers presented at the Rubber and Plastics sessions was given by the Division's Technical Sessions Chairman F. J. Wehmer. Of the nine papers presented, only those on the application and fabrication of expandable polystyrene, new developments in silicone rubber, and designing with rigid polyvinyl chloride are available in pamphlet form.

Safety. A discussion of the importance of securing basic safety through engineering at the planning and development levels as applied at Oldsmobile, and the method of planning safety into automation used at Pontiac were presented.

Metals Engineering. A lecture by Raymond L. Mattson, assistant head, engineering, mechanical department of General Motors, on the "Residual Stresses, Cold Working, and Fatigue of Metals," sponsored by the Metals Engineering Division emphasized practical problems particularly in the residual-stress and cold-working area, and also reviewed current research efforts.

Nuclear Engineering. Some notes on the strength of the Enrico Fermi reactor vessel structure, and a discussion of the environmental studies for that reactor also led to a discussion of the Chalk River reactor mishap. Operation of centrifugal pumps for pressurized-water reactors, operating experience with a swimming-pool-type research reactor, and technical design of the Dresden boiling-water reactor were the other topics of papers.

Instruments and Regulators. The Military Standard No. 206 torque tester, an analytic frequency-response solution for a higher order servomechanism with a nonlinear control element, and subharmonic oscillations which may exist in nonlinear systems having odd restoring forces were discussed.

Machine Design. Several papers on linkages—one concerned with their design to generate functions of two variables, another on their use to replace gears—an analytical design of an Ackermann steering linkage, and structural-error analysis in plane kinematic synthesis were presented.

A theoretical and experimental investigation of elastic shear stresses and deflection in an axially loaded helical spring were described, and the solution to the design of helical springs for minimum weight, volume, and length was given. Other papers dealt with stress and strain in spinning paraboloid dishes; the fundamental design principles and objectives of trip-free mechanisms commonly employed in power-circuit breakers; the advantages, installation details, and performance of an electromagnetic multidisk clutch; the effect of shot-peening on fatigue strength; dynamic loading of spur-gear teeth; and a more detailed analysis of strain and stress of different types of pins.

Heat Transfer. Regenerative heat exchangers, heat exchangers having internal-heat sources, calculation of forging cooling rates, thermal conductivity of aluminum-honeycomb material near room temperature, leakage and elastic characteristics of compressed-asbestos sheet packing, transient-temperature distribution and thermal stresses in a hypersonic unsymmetrical wing structure, transient temperature of well-stirred air in an enclosure with heat losses, wave theory of heat transfer in film boiling, heat-transfer charts for time-variable boundary conditions, a boundary-layer treatment of laminar-film condensation, an analytical solution heat and mass transfer such as would be expected for aqueous-homogeneous internally cooled nuclear-power reactors, and an experimental and analytical study of vortex-flow temperature separation were the topics of the papers presented at four Heat-Transfer sessions.

Hydraulics. Studies of jet compressions, technical considerations for the application of hydraulic torque converter, Progress-Thru machines, the prediction of choking flow in centrifugal impellers, the friction factors for turbulent flow in curved pipes, and a review of some of the recent advances in understanding the transition from laminar to turbulent shear flows were presented in the Hydraulic Division sessions.

Consulting Engineering. The ASME Committee on Professional Practice of Consulting Engineering and the Consulting Engineers Association of Michigan sponsored a panel discussion on the consulting engineer and his registered and nonregistered employees, his relations with his clients and vendors, and with his technical societies.

Inspection Trips

Inspection trips were taken to the General Motors Technical Center, to the Ford Motor Company's River Rouge Plant, The Chrysler Mound Road V-8 Engine Plant, and to the Detroit Edison's River Rouge Plant and the Enrico Fermi Atomic Power Plant.

Women's Program

The five-day program arranged for the women visiting in Detroit during the Semi-Annual Meeting was as well thought out as any of the sessions—technical or social—planned for their husbands.

All of the social events of the general meeting program were, of course, as much for them as the conferees; but, in addition, the women had a Coffee Hour every day that they were not off on a trip too early in the morning.

The day-by-day schedule for the women was busy, enjoyable, as well as informative.

The festivities opened on Sunday, June 15, with the "Early Bird" Party. This event continues to grow in popularity; inasmuch as it gives everyone an opportunity to renew old friendships and make new acquaintances. It is also a good time to make plans for the duration of the meeting.

On Monday, after the President's Luncheon, the women were off on a tour of Detroit. They traveled over the Civic Center Expressways, saw Boulevard Area, the Wayne State University and Art Center, and the trip ended at the Rackham Building where they attended a tea in their honor. In the evening there was the starlight cruise of the Detroit River and lake front. After a buffet dinner aboard the Bob-lo flagship, the cruise took off on a 45-mile trip down river to a point below the Great Lakes Steel Corporation, then across the river up to the Canadian side, past Belle Isle to Windmill Point, and then back to Detroit. Music by a popular orchestra was provided for dancing on shipboard.

More sight-seeing on Tuesday. A bus tour, including Lake St. Clair and Grosse Pointe, terminated at General Motors Technical Center for an "inspection tour." Then by bus, the women were taken to Eastland Shopping Center where they attended a luncheon and fashion show held in the Anchor Room of the J. L. Hudson Company. We have it on the best authority that the "free time" for shopping in the Center was not wasted—the Center itself is described in superlatives.

Wednesday afforded the women a choice. The trip was planned for the Ford Motor Company's Dearborn plant. The women could either go on a tour of the Dearborn plant or the Ford Museum. In the afternoon after luncheon in the

Business Meeting and United Engineering Center

ASME Officers Nominated for 1959

MEMBERS of the ASME Nominating Committee for 1958, A. B. Hieberg, *chairman;* C. A. Davis, *secretary;* R. M. Scott, J. L. O'Neill, G. R. Leavitt, K. R. Daniel, L. C. Koke, R. B. Kinzbach, J. H. Davis, A. William Meyer, and Robert Nelsen, have nominated for 1959 the following:

Office	Nominee
President	Glenn Barton Warren
Vice-President (for two years)	C. H. Coogan, Jr., Region I (one year)
	G. R. Hahn, Region II
	J. W. Little, Region IV
	T. H. Dolan, Region VI
	Harold Grasse, Region VIII
Directors (for four years)	A. M. Perrin
	R. G. Folsom

AT THE Business Meeting of the Society, held June 17, 1958, during the Semi-Annual Meeting, the following announcements were made:

The 1959 Semi-Annual Meeting will be held in St. Louis, Mo., June 14 through 18, with air-conditioned facilities assured.

The personnel constituting the 1959 Nominating Committee was recorded. (See page 135 of this issue.—Editor).

At the close of the Business Meeting, W. F. Ryan, past-president and Hon. Mem. ASME, made a report on the member-giving campaign for the new United Engineering Center. Dr. Ryan stated that the ASME would be relying on the Section organization to raise the money in the member-giving campaign. He urged members to serve on the teams of solicitors which the Executive Committee of each Section would be appointing since all of the member gifts would be on the basis of personal solicitation wherever possible. All of the Founder Societies are following essentially the same plan under the advice of professional consultants. These, the members would be glad to know, he stated, were on a straight fee and not a percentage basis. A Central Committee organized around the eight Regional Vice-Presidents will assign quotas to cities, sections, and subsections. The large-gifts portion of the campaign has already begun with a few but substantial gifts—the average is over $700—already subscribed. The large industries campaign headed by Mervin J. Kelly of Bell Laboratories has received 95 subscriptions averaging over $30,000 for a total of $3 million. Dr. Kelley already has more than half of his $5-million quota subscribed with less than a third of his list actually solicited.

In the Greater New York area, Dr. Ryan reported, a special Five Founder Societies' committee of which ASME Vice-President W. H. Byrne, Metropolitan section, is co-chairman will solicit other industrial and commercial concerns not covered by Dr. Kelley's group. Mr. Byrne also is in charge of the member-giving campaign for the ASME Metropolitan Section. Dr. Ryan suggested that other sections might organize their campaign along similar lines. He also reported that Mr. Byrne returned from the annual meeting of the National Association of Power Engineers with an unexpected donation of $50,000 from that organization.

The building site is substantially cleared. One portion was delayed until the fall by a few remaining tenants.

main dining room there was the choice of the Ford Museum, a carriage trip through Greenfield Village, or Dearborn Inn.

In the evening—the Social Hour and Banquet.

There were no formal plans for Thursday; however, several of the women of Detroit graciously made themselves available to help out on any special trips the visitors were interested in taking.

Committees in Charge

ASME meetings come under the general supervision of the Meetings Committee.

The technical program is provided by the Society's professional divisions and technical committees. Other features are planned and supervised by committees organized within the host section—in this case, the Detroit Section. In grateful acknowledgment of the many committees whose efforts contributed so substantially to the success of the 1958 Semi-Annual Meeting their personnel is listed as follows:

Meetings Committee: G. R. Fryling, *chairman;* W. B. Wilkins; A. M. Gompf; H. N. Muller, Jr.; K. L. Selby; R. E. Jonelis; and B. M. Bailey.

Detroit Section: G. H. Howell, *chairman;* A. F. L. Anderson, *vice-chairman;* R. D. Harvey, *secretary;* and Albert Chapman, *treasurer.*

Central Michigan Subsection: J. T. Anderson, *chairman;* R. T. Hamilton, *vice-chairman;* C. W. Hall, *secretary;* and F. Sarns, *treasurer.*

Saginaw Valley Subsection: P. H. Valentyne, *chairman;* R. W. Capper, *vice-chairman;* C. W. Digby, *secretary;* and J. C. McManmon, *treasurer.*

General Arrangements Committee: H. F. Gandelot, *chairman;* J. E. Bumgardner, *co-chairman;* and A. C. Pasini, *consultant.*

Meetings Arrangements and Hotels: W. W. Gilbert, *chairman;* and George Lahodny.

Reception Committee: J. W. Armour *chairman;* D. E. Newkirk, *assistant, chairman;* P. W. Thompson; R. M. Van Duzer; E. L. Weaver; Mrs. R. C. Crans; Mrs. Robert Harvey; and Mrs. James Page.

Finance Committee: V. P. John, *chairman;* Albert Chapman; E. B. Wolf; R. C. Austin; W. K. Bodger; and R. B. Bates.

Registration and Information Committee: D. H. Corey, *chairman;* William Dull; Leonard Kane; and Charles Heidel.

Technical Events Committee: John Uicker, *chairman;* H. W. Bowersox; G. M. Kurajian; H. E. Mayrose; D. L. Perkins; and J. F. Jarnagin.

Banquet and Entertainment Committee: O. A. Soderberg, *chairman;* A. C. Coppola; J. F. Donovan, Jr.; H. A. Goss; and James Page.

Plant Visits Committee: R. F. Hanson, *chairman;* R. J. Brandon; Seymour Lipten; Russell Parkinson; and A. A. Santilli.

Publicity Committee: A. S. Griswold, *chairman;* and Paul Van der Meer.

Old Guard Committee: J. W. Armour, *chairman;* H. S. Ford; D. L. Perkins; and P. W. Thompson.

Women's Program: Mrs. R. C. Crans, *chairman;* Mrs. A. F. L. Anderson; Mrs. Albert Beam; Mrs. H. K. Gandelot; Mrs. E. B. Wolf; and Mrs. E. W. Burstadt.

Availability List: 1958 ASME Semi-Annual Meeting Papers

THE papers in this list are available in separate copy form until April 1, 1959. Please order only by paper number; otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 25 cents each to members; 50 cents to nonmembers.

Paper No. *Title and Author*

Fuels

58—SA-50 A Modern Safeguard for Automatic Boilers, by P. E. BUDAY

58—SA-56 Burner Maintenance, by R. D. REED

58—SA-58 Simplification of Gas-Fired Heat Processes, by R. C. LEMAY

58—SA-62 Computer Reduces Man-Hours in Fuel Analysis Calculations, by C. J. WEGERT and W. H. GUPPY

Gas Turbine Power

58—SA-20 The Measured and Visualized Behavior of Rotating Stall in an Axial-Flow Compressor and in a Two-Dimensional Cascade, by GINO SOVRAN

58—SA-21 Stage Performance and Radial Matching of Axial Compressor Blade Rows, by JEFFREY WATKINS

58—SA-25 Design and Development of a Supercharger for a Pressure-Fired Boiler, by R. C. REISWEBER, J. W. GLESSNER, and J. R. SHIELDS

58—SA-26 Some Thoughts About the Development of Automotive Gas-Turbine Units, by A. T. BOWDEN and W. HRYNISZAK

58—SA-55 Determination of Erosion in Turbojet-Fuel Nozzles by Radiochemical Techniques, by H. R. HAZARD, P. GLUCK, and R. W. TATE

Heat Transfer

58—SA-1 The Thermal Conductivity of Aluminum-Honeycomb Material Near Room Temperature, by R. V. DUNKLE, J. T. GIER, and J. T. BEVANS

58—SA-2 A Boundary-Layer Treatment of Laminar-Film Condensation, by E. M. SPARROW and J. L. GREGG

58—SA-3 Transient Response of Heated Air in an Enclosure With Heat Losses, by W. A. WOLFE

58—SA-4 The Calculation of Forging Cooling Rates, by D. P. TIMO and R. M. GOLDHOFF

58—SA-7 Heat-Transfer Charts for Time-Variable Boundary Conditions, Part 1—Semi-Infinite Solid, by T. J. MIRSEPASSI

58—SA-19 Wave Theory of Heat Transfer in Film Boiling, by YAN PO CHANG

58—SA-28 Leakage and Elastic Characteristics of Compressed-Asbestos Sheet Packing, by J. J. WHALEN

58—SA-29 Regenerative Heat Exchangers With Heat-Loss Consideration, by E. K. DABORA

58—SA-30 Modified Boundary-Layer-Type Solution for Free-Convection Flow in Vertical Closed Tube With Arbitrarily Distributed Internal-Heat Source and Wall Temperature, by F. G. HAMMITT

58—SA-39 Dynamic Response of Heat Exchangers Having Internal-Heat Sources—Part 3, by V. S. ARPACI and J. A. CLARK

58—SA-63 Transient Temperature Distribution and Thermal Stresses in a Hypersonic Unsymmetrical Wing Structure at Angles of Attack, by SHIH-YUAN CHEN

58—SA-71 An Experimental and Analytical Study of Vortex-Flow Temperature Separation by Superposition of Spiral and Axial Flows, by J. E. LAY

Hydraulic

58—SA-13 Studies of Jet Compression—Part 1, Apparatus and Methods. Results With Air at Room Temperature, by H. J. HOGE, SUZANNE S. EICHACKER, and D. L. FISKE

58—SA-14 Friction Factors for Turbulent Flow in Curved Pipes, by H. Ito

58—SA-15 Prediction of Choking Flow in Centrifugal Impellers, by HAROLD LOWN and F. J. WIESNER, JR.

58—SA-64 Technical Considerations for the Application of Hydraulic Torque Converters, by H. J. WIRRY

Instruments and Regulators

58—SA-34 Antifriction Instrument-Bearing Torque Testing and the Resistance to Motion of Such Bearings, by A. B. ASCH

58—SA-35 An Analytic Frequency-Response Solution for a Higher Order Servomechanism With a Nonlinear Control Element, by A. M. HOPKIN and K. OGATA

Lubrication

58—SA-54 A Variational Approach to Lubrication Problems and the Solution of the Finite Journal Bearing, by D. F. HAYS

Machine Design

58—SA-8 Stress and Strain in Spinning Paraboloid Dishes, by M. J. COHEN

ASME President J. N. Landis and Presidential-Nominee Glenn Warren inside the containment building for the Enrico Fermi Atomic Power Station. The reactor vessel which was recently delivered and is being made ready for installation is seen behind them at the right.

Harry Holingshaus, University of Utah, final winner in the Student Member Competition for the Old Guard Prize, is congratulated by Richard A. North, Mem. ASME

58—SA-9 Design of Helical Springs for Minimum Weight, Volume, and Length, by R. T. HINKLE and I. E. MORSE, JR.
58—SA-12 Structural Error Analysis in Plane Kinematic Synthesis, by FERDINAND FREUDENSTEIN
58—SA-18 Helical Springs of Hollow Circular Cross Section, by C. W. BERT
58—SA-23 The Pin, by M. J. SCHILHANSL
58—SA-31 Analytical Design of an Ackermann Steering Linkage, by W. A. WOLFE
58—SA-32 Dynamic Loading of Spur Gear Teeth, by A. Y. ATTIA
58—SA-33 How to Replace Gears by Mechanisms (Linkages), by KURT HAIN and GERHARD MARX
58—SA-46 Effect of Shot-Peening on Fatigue Strength, by R. P. FELGAR
58—SA-57 The Design of Linkages to Generate Functions of Two Variables, by C. W. ALLEN
58—SA-61 Electromagnetic Multidisk Clutches . . . Performance and the Influence of Various Disk Types Upon the Clutch Characteristics, by C. NITSCHE

Maintenance and Plant Engineering

58—SA-69 Training Maintenance and Engineering Personnel, by R. G. SMITH
58—SA-70 Role of Petroleum-Base Rust and Corrosion Preventives in Plant Maintenance, by R. A. FITCH

Management

58—SA-6 A Blueprint for the Storage and Retrieving of Coded Mechanical-Engineering Data, by EDNA GENEVIEVE GILBO
58—SA-27 Technical Data on Border-Punched Cards, by GUNTHER COHN
58—SA-37 How Do Research Scientists Spend Their Time? by G. A. PETERS and MAX LEES
58—SA-45 Engineer-Retention, by J. D. STALEY
58—SA-47 Concepts of Job Assignment in the Project-Type Engineering Department, by C. H. CROSBY
58—SA-48 Flow Modulator for K-F Direct-Contact Regenerative Heat System, by H. A. KULJIAN and H. S. C. CHEN
58—SA-49 The Orderly and Economic Handling of Engineering Data, by T. W. SCHWARTZ

National Junior Committee

58—SA-51 Who Controls Your Future? by T. J. FEAHENY, C. M. LADD, and R. I. WALKER, JR.

Nuclear Engineering

58—SA-73 Technical Design of the Dresden Nuclear Power Station, by L. E. FOSTER
58—SA-74 The Operation of Centrifugal Pumps in a Pressurized-Water Reactor Plant, by L. F. EMERSON

Power

58—SA-5 Electrostatic Shaft Voltage on Steam-Turbine Rotors, by J. M. GRUBER and E. F. HANSEN
58—SA-10 A Review of Engineering Considerations for the River Rouge Power Plant, by G. A. PORTER and W. L. WINGERT
58—SA-16 Availability Balance of Steam-Power Plants, by C. A. MEYER, G. J. SILVESTRI, and J. A. MARTIN
58—SA-17 Operating Results of an Experimental Supercritical Steam Generator, by E. DAMAN, H. PHILLIPS, J. VAIL, and S. LING
58—SA-22 Design of 321-Mw Cross-Compound Steam Turbine—River Rouge Unit No. 3, by C. D. WILSON
58—SA-24 Pulverized-Coal Transport Through Pipes, by R. C. PATTERSON
58—SA-36 The Control System of a 225,000-Kw Double-Automatic Extraction Steam Turbine and Related Reducing Stations, by M. A. EGGENBERGER and P. G. IPSEN
58—SA-38 Low-Pressure Turbine Testing, by J. E. DOWNS and K. C. COTTON

Process Industries

58—SA-59 Mathematical Relationships for Computer-Control Systems, by T. M. STOUT
58—SA-60 An Example of System Design by Logic, by E. S. TAYLOR

Production Engineering

58—SA-11 A Look at Russian Automation and Technical Developments, by N. L. BEAN
58—SA-40 Factors Influencing the Performance of Grinding Wheels, by E. J. KRABACHER
58—SA-41 A Study of the Effects of Tool-Flank Wear on Tool-Chip Interface Temperature, by D. R. OLBERTS
58—SA-42 Controlled Contact Cutting Tools, by B. T. CHAO and K. J. TRIGGER
58—SA-43 Beryllium Machining Characteristics, by D. R. WALKER
58—SA-44 Grinding a Titanium Alloy With Coated Abrasives, by D. E. CADWELL, H. L. WEISBECKER, and W. J. MCDONALD
58—SA-52 Automation Progress in the United States, by L. D. MILLER
58—SA-53 The Effect of a Lead Additive on the Machinability of Alloy Steels, by NORMAN ZLATIN and J. V. GOULD
58—SA-72 Minimizing Waste in Strip Cutting, by G. G. O'BRIEN

Rubber and Plastics

58—SA-65 Expandable Polystyrene . . . Applications and Fabrications, by D. F. REDMAN
58—SA-66 New Developments in Silicone Rubber, by G. M. KONKLE
58—SA-67 Designing With Rigid Polyvinyl Chloride, by M. BATIUK and J. A. ROLLS
58—SA-68 Development of Sandwich-Construction Refrigerator Cabinets, by F. R. MARSHALL

1958 West Coast Applied Mechanics Conference, September 8–10, to Be Held in Los Angeles at the University of California

ASME-ASCE joint meeting to cover latest advances in five important fields of applied mechanics

THE 1958 West Coast Conference of Applied Mechanics will be held at the University of California at Los Angeles, September 8–10.

This six-session conference is sponsored by the Applied Mechanics Division of The American Society of Mechanical Engineers in conjunction with the American Society of Civil Engineers.

Designed to cover the latest advances in the field of applied mechanics, the technical program lists two sessions on plates and four sessions in which shock, vibration and impact, shells, and stress analysis and materials will be the topic of discussion.

▶MONDAY, SEPTEMBER 8

Registration 8:30 a.m.

Session 1—Plates 9:30 a.m.

Chairman: *J. G. Berry*, Ramo-Wooldridge Corp., Los Angeles, Calif.

Bending of Elastically Supported Rectangular Plates,[1] by *M. Zaid* and *Marvin Forray*, Republic Aviation Corp.

A Refined Theory of Elastic Orthotropic Plates, by *S. J. Medwadowski*, University of California, Berkeley (Paper No. 58—APM-16)

Elastic Bending of Layered Plates,[1] by *K. S. Pister* and *S. Dong*, University of California, Berkeley

Transient and Residual Stresses in Heat-Treated Plates, by *H. G. Landau* and *J. H. Weiner*, Columbia University (Paper No. 58—APM-14)

Session 2—Plates 2:00 p.m.

Chairman: *J. F. Brahtz*, J. H. Pomeroy and Co.

Large Deflection of Stiffened Plates, by *W. G. Soper*, Los Alamos Laboratories, Los Alamos, N. Mex. (Paper No. 58—APM-18)

Large Symmetric Deflections of Annular Plates, by *G. Wempner* and *R. Schmidt*, University of Illinois (Paper No. 58—APM-12)

Effective Widths of Thin Rectangular Plates,[1] by *M. Ojalvo* and *F. H. Hull*, Princeton University

Strain Hardening Solutions to Plate Problems,[2] by *Nicholas Perrone* and *P. G. Hodge, Jr.*, Polytechnic Institute of Brooklyn

▶TUESDAY, SEPTEMBER 9

Registration 8:30 a.m.

Session 3—Shock 9:30 a.m.

Chairman: *G. W. Housner*, California Institute of Technology

Some Shock Spectra Characteristics and Uses, by *Y. C. Fung*, California Institute of Technology and *M. V. Barton*, Ramo-Wooldridge Corp., Los Angeles, Calif. (Paper No. 58—APM-5)

Response of Complex Structures From Reed Gage Data, by *Sheldon Rubin*, Hughes Aircraft Corp., Culver City, Calif. (Paper No. 58—APM-15)

The Plastic Deformation Due to Impact of a Cantilever Beam With an Attached Tip Mass, by *T. J. Mentel*, University of Minnesota (Paper No. 58—APM-4)

Dynamic Loading Tests of an Aircraft-Type Beam,[2] by *E. A. Ripperger*, University of Texas and *W. R. Barton*, Sandia Corp., Albuquerque, N. Mex.

Session 4—Vibration and Impact 2:00 p.m

Chairman: *W. Goldsmith*, University of California, Los Angeles

The Vibration of a String Having a Uniform Motion, by *F. R. Archibald* and *A. Emslie*, Arthur D. Little, Inc., Cambridge, Mass. (Paper No. 58—APM-7)

Stresses Produced in a Half Plane by Moving Loads, by *J. Cole*, California Institute of Technology and *J. H. Huth*, The Rand Corp., Santa Monica, Calif. (Paper No. 58—APM-8)

Some Solutions of the Timoshenko Beam Equation for Short Pulse-Type Loading, by *H. J. Plass, Jr.*, University of Texas (Paper No. 58—APM-3)

Response of a Simply-Supported Timoshenko Beam to a Purely Random Gaussian Process, by *J. C. Samuels* and *A. C. Eringen*, Purdue University (Paper No. 58—APM-1)

▶WEDNESDAY, SEPTEMBER 10

Registration 8:30 a.m.

Session 5—Shells 9:30 a.m.

Chairman: *J. N. Goodier*, Stanford University

Analysis of the Four-Flange Shell by Transfer Matrices,[2] by *Eduard Pestel*, Technical University, Hanover, Germany

A Method of Computing Transfer Matrices,[2] by *Eduard Pestel* and *Georg Schumpich*, Technical University, Hanover, Germany

The Flexure of a Uniformly Pressurized Circular Cylindrical Shell, by *J. D. Wood*, The Ramo-Wooldridge Corp., Los Angeles, Calif. (Paper No. 58—APM-13)

Influence Coefficients for Edge-Loaded Short Thin Conical Frustrums,[2] by *J. H. Baltrukonis*, The Ramo-Wooldridge Corp., Los Angeles, Calif.

Session 6—Stress Analysis and Materials 2:00 p.m.

Chairman: *G. Zitkas*, University of California, Los Angeles

Torques Loaded Continuous Beams of Profile Sections,[1] by *D. H. Young*, Stanford University and *J. F. Brahtz*, J. H. Pomeroy and Co.

A Theory of Elastic, Plastic, and Creep Deformations of an Initially Isotropic Material Showing Anisotropic Strain-Hardening, Creep Recovery, and Secondary Creep, by *J. F. Besseling*, Stanford University (Paper No. 58—APM-17)

Pitch and Curvature Corrections for Helical Springs, by *C. J. Ancker, Jr.*, Analco Services Co., Chicago, Ill., and *J. N. Goodier*, Stanford University (Paper No. 58—APM-10)

Theory of Pitch and Curvature Corrections for the Helical Spring, Part 1 (Tension), by *C. J. Ancker, Jr.*, Analco Services Co., Chicago, Ill., and *J. N. Goodier*, Stanford University (Paper No. 58—APM-11)

Theory of Pitch and Curvature Corrections for the Helical Spring, Part 2 (Torsion), by *C. J. Ancker, Jr.*, Analco Services Co., Chicago, Ill., and *J. N. Goodier*, Stanford University (Paper No. 58—APM-9)

Physical Properties of Plastics for Photothermoelastic Investigations (By Title),[2] by *Herbert Tramposch* and *George Gerard*, New York University (Paper No. 58—APM-2)

[1] Paper sponsored by ASCE.

[2] Paper not available—see box on page 122.

[2] Not presented orally; preprint available at preprint desk.

U. S. Civil Service Commission Approves Policy to Recruit Engineers for Federal Agencies Through ESPS

A NEW policy, as set forth in the United States Civil Service Commission's Departmental Circular No. 949, now permits the use of certain employment agencies and specifically mentions only the Engineering Societies Personnel Service (ESPS), a nonprofit service sponsored by professional engineering societies, as an example of a nonprofit professionally sponsored employment service under this new recruitment program to recruit engineers and scientists for Federal Agencies.

The policy is designed specifically to make available to Federal Agencies another means of attracting applicants to hard-to-fill engineering and scientific positions. It makes available to governmental agencies the extensive local, regional, and national coverage extended by the Societies through ESPS. In order to preserve the basic principle that no one shall be required to pay a fee to secure federal employment, each agency will make its own arrangements and execute its own agreement to pay to the participating employment services any fees charged for successful placement under this program. Agencies should determine that they have the legal authority to use their funds for these purposes before participating in the program.

This now means that an applicant may receive a Federal position without payment of any fee since the ESPS fee will be paid by the Government Agency.

It permits ESPS to render the same assistance to governmental agencies as it has provided to private employers for the past 40 years.

The ESPS, sponsored by and co-operating with the American Society of Civil Engineers, The American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the American Institute of Mining, Metallurgical and Petroleum Engineers, has offices at 8 West 40th S , New York 18, N. Y.; 100 Farnsworth Avenue, Detroit, 2, Mich.; 84 East Randolph Street, Chicago 1, Ill.; and 57 Post Street, San Francisco 4, Calif.

The Cleveland Story—
Materials-Handling Conference and Exhibit

With 14,000 men of industry attending the exposition, some 400 engineers joined the conference on Materials Handling. Did you know that the average part is handled 100 times in its passage through a plant?

A SPEAKER, quoting a Westinghouse report, said, "Moving of materials consumes 26 per cent of all man-hours in a plant." That's the background. It explains why another speaker could report that materials handling has developed—in the past ten years—into "a disciplined science with a mathematical base."

The growing art of materials handling calls for exchange of information. The men of this specialty met at the great Public Auditorium in Cleveland, Ohio. Time of the meeting: June 9–12, 1958. The occasion: The Conference sessions held by the Materials Handling Division of The American Society of Mechanical Engineers, in co-operation with the Society's Cleveland Section, and the biannual "National Materials Handling Exposition," a $5-million show displaying some 6000 products, put on by the New York firm of Clapp & Poliak.

Attendance at the exposition was 14,000. Present at the conference: Just under 400 engineers of the United States and foreign countries. A group of visiting engineers from Japan heard the technical papers by means of earphones and a translating setup like the one used at the United Nations.

Long Corridors of Mechanical Engineering

The exposition promised "Acres of exhibits. . .(displaying). . .an immense variety of machines, equipment, services, and supplies to move materials better and with less manpower, and with greater efficiency and lower cost." It made its promise good. The American gift for mechanical invention stood revealed in the products of some 200 manufacturers and specialists in the handling of materials.

The thousands who came from all over the world could scarcely hope to "do" the show in a single day. Throughout the afternoons of the exhibition, throngs moved along the corridors, studying displays that ranged from huge earth-moving machinery to collapsible containers, from storage rack clamps to mobile cranes.

What's new in pallets and forked trucks? Developments were apparent in a number of displays. Nearby were the conveyer belts, the roller conveyers, the overhead tracks. Notable in this department were the air conveyers in which material is carried through tubes in a moving column of air. Crowds were drawn to an air-conveyer display in which the ducts were of glass and the transmission process could be observed.

Want to lift 20 tons by a vacuum? Need a single-wheel device enabling one man to shunt freight cars? Does your plant need a radio pager, a fully powered steel strapping tool, a power sweeper? The 14,000 saw these things, studied them, and compared them. Are you having trouble with breakage in shipments? There were air-bag cushions for protecting freight shipments. Visitors went through the underground passageways, under Lakeside Avenue, to the rail siding, where freight cars displayed

the latest in shipping equipment—new racks, and containers, and dividers, inside the cars.

The Air Force presented a cutaway of its enormous transport, the C-133 series, the Douglas turboprop that lifts a cargo of 90,000 lb. The Department of Supply and Logistics offered a booklet portraying the military's solutions to its worldwide problems of packaging and materials handling—a booklet turned out in such mouth-watering style as to win recruits.

Bringing Engineers Together

V. J. Reade of Whitehead Metal Products, New York City, served as General Chairman of the conference. Mr. Reade is a member of the executive committee for the Materials Handling Division. He took part in an interview with a Cleveland television newscaster, telling the people of the area about the exhibit. He shared with T. A. Marshall, Jr., senior assistant secretary of the Society, the duty of opening the technical sessions, welcoming the assembled engineers and introducing the session chairmen.

There is controversy in the business community on the value of "operations research" as undertaken in the past ten years. The scientific method engenders awe at the more startling results; but there remains suspicion that research cannot accomplish all that it promises. This controversy was brought out by D. B. Hertz, Mem. ASME, of Arthur Andersen and Company, who delivered the first paper at the opening session. Advocates of the new discipline feel strongly that it is a powerful tool of management in making decisions. Management must work by intuition, or it must adopt the engineering method.

Through examples, Mr. Hertz illustrated the tug of war between safety margins and low cost. High inventories, extra facilities, stand-by labor: They represent safety, but they cost money. In the area of materials handling, a typical problem would be that of truck-dock space. How much truck-dock space should be provided in the warehouse, taking into account uncertain demand and the cost of trucks waiting in line?—the cost in money, or in customer good will. To deal with this, there is a part of operations-research technique called "waiting-line theory."

In his paper, written in collaboration with K. H. Schaffir, also of Arthur Andersen and Company, Mr. Hertz cited two instances of the application of the engineering method. For a pulpwood operation—cutting pulpwood and getting it to the paper mill—he revealed the problems of the economic operation of woodlands—how much cutting, how much transport on rails, on trucks, and on water; how to meet the problem of seasonal work. He had arrived at a cutting and inventory schedule which minimized total operating costs. The system called for the use of a large-scale computer for a few minutes each time a quarterly schedule was required.

In the planning of a truck fleet for wholesale milk deliveries, the questions to be answered were: What combinations of trucks, what routes to use, what customers to accept or drop? The phrase "stop densities," came up. The engineering method produced a program that called for different truck sizes, substantially different routes, and different routes on different days. The saving: 20 per cent in operating costs, which in this case meant 20 per cent of gross profit.

Money—or Brains

A. M. Perrin, Mem. ASME, president of National Conveyors Company, made the point that a company can best meet competition by increasing the vital effectiveness of its engineering department.

Addressing himself mainly to his fellow manufacturers of materials-handling equipment, he said: "If you can't invest in machinery, like a huge company, invest in brains—engineering brains. Let them find ways to design and produce a better product that can be installed economically." His firm maintains a model plant enabling engineers to try out their ideas and to learn how the customer's material behaves.

Allan Harvey, a partner in the Dasol Corporation, spoke on "Systems Engineering," where the most rewarding results often show up in small companies with small budgets.

Systems engineering, he said, is a new way of thinking about business operations, going far beyond the motion studies of the past. It is an appeal for ideas in advance. Mass production is simple: But when you do a large number of things a few times, you need new concepts.

His credo: The whole has efficiencies of its own, greater than the efficiencies of its parts. There is no difference between paper work, manufacturing, and warehouse handling. It's all part of the process, part of the new technology.

J. R. Bright, Mem. ASME, and Associate Professor at Harvard's Graduate School of Business Administration, delighted the conference with a paper that might have been entitled, "How Do You Live With the New Mechanization?" By "new mechanization," he meant the compounding of machine tools (many operations performed at one station), remote control, punched-tape programing, feedback (telling the machine to correct itself), mechanized inspections, and mechanized assembly. These things produce improved quality and improvement in lead time; they save space and demand less skilled labor among the operating people. But living with the new mechanization may take some doing.

Fourteen thousand engineers and plant officials roam the exposition, observing developments in materials handling, from intake of raw material to packaging the product.

Materials handling—6730-lb worth. In every aisle of the exhibition, the theme was convenience, speed, low cost, mechanization. Manufacturers represented: 200.

On camera. V. J. Reade (white suit) of the Executive Committee of the Materials Handling Division, is interviewed by Pete French, television newscaster, reporting high lights of the exposition at the Cleveland Auditorium. Mr. Reade, of Whitehead Metal Products, New York, N.Y., was general chairman of the conference.

Gentlemen of Japan. Standing: M. Muramatsu, Japanese interpreter, International Cooperation Administration. Seated, *left to right:* K. Chikamatsu, of Hitachi, Ltd.; T. Shiga, of Furukawa Electric Co.; and K. Endo, of Chiba Technical College.

The Cleveland Story

Inflexible? Well, Yes

The highly automatic plant does tend to be inflexible. Moreover, it is just as inflexible on the input side as on the output side. Just as it won't produce a defective part, neither will it accept slightly defective stock. An example is the plant making ice-cream sandwiches, where trouble developed because they couldn't achieve "cookie control," couldn't prevent the machine from rejecting the wafers that went on each side of the ice cream. One plant found it necessary to "store improvements," making one big change and avoiding smaller, more frequent changes. And there was the plant that couldn't be shut down. Rather, it couldn't be restarted without great difficulty. The answer: they "cycled it empty" on Saturdays and Sundays.

Professor Bright made the point that automation must be a success mechanically, economically—and socially.

Just Waft It From Here to There

At the Tuesday session, June 10, the conference heard from H. A. Markel, Jr., chief engineer of the Fuller Company; G. A. Tamblyn of Yale & Towne; and H. C. Ellis of Booz, Allen & Hamilton, management consultants.

Mr. Markel presented a paper on pneumatic conveying systems. Pneumatic conveying is a highly developed art, but there are possibilities in new combinations of the recognized elements. In a "fluidizing" conveyer, the material delivered is a function of pressure and distance: The longer the distance or the less the pressure, the less the material delivered. The pneumatic conveyer may be the choice where space is at a premium.

Mr. Tamblyn spoke on the marketing of mechanization equipment and services, while Mr. Ellis took up the problems of the nonmass-producing plant. Whereas the mass producers learned early that they had to have good handling, the concept is only now spreading to the job-shop type of operation.

The third session heard R. C. Tench, of the Chesapeake and Ohio Railroad, tell of the modern high-capacity, bulk-handling system, in which coal cars are emptied by inverting them (the rotary car dumper), and movement of coal from steamship to bin is accomplished at 2000 tons per hr. He presented a C&O movie entitled "Coal Bin for the World." Foreign countries take 58 million tons of our coal each year.

O. S. Carliss, Mem. ASME, director of engineering for Yale and Towne, Philadelphia, discussed industrial trucks.

"Either material is delivered to the workman on time," he said, "or costs go up. We're past the point where big and spectacular economies are possible. This is the era of refinement and improvement."

He listed current developments as new materials for wheels (three times the load-carrying capacity, and ten times the life of rubber), new mufflers to take carbon monoxide from truck engines used in plants, and new batteries with 25 to 40 per cent more power in the same battery box.

W. J. Dollard, of the Westinghouse Atomic Power Department, spoke on the development of nuclear handling equipment. Remote handling operations are a must in the rapidly developing nuclear industry.

Mr. Dollard also stated his belief that the same methods will be used in the remotely controlled automatic factory.

On Thursday, the final day of the conference, Frank Ring, Jr., Mem. ASME, of Oak Ridge National Laboratory, carried on the story of remote handling equipment, the wall-transfer devices, the tongue devices that reach in and grasp radioactive material, the pistol-grip controls. A phrase to remember: "Master side to slave side." Mr. Ring showed a movie called "Engineering for Radioisotopes."

Col. L. W. Winget, of the U. S. Army Engineer Research and Development Laboratories, Fort Belvoir, Va., discussed the equipment needed in support of the missile program—the fact that mobility demands that everything be compact. He presented charts of the Department of the Army and answered questions on how to deal with the government.

Final speaker was M. L. Mastracci, of American Machine and Foundry, Greenwich, Conn., who spoke on the handling of missiles. He reported, with regret, that handling men were backward about demanding changes in missiles to facilitate handling—easily talked out of changes.

"We ship a missile 3000 miles," he said, "to fire it 5000. All the vehicles, including police escort, are part of the materials-handling problem. All must be idiotproof."

1958 ASME Petroleum Mechanical Engineering Conference in Denver, September 21–24, Program Announced

THE thirteenth annual Petroleum Mechanical Engineering Conference of The American Society of Mechanical Engineers will be held September 21–24, at the Cosmopolitan Hotel, Denver, Colo. The meeting is sponsored by the ASME Petroleum Division with the co-operation of the Rocky Mountain Section.

Denver, the rapidly developing oil operations center, would be attraction enough for petroleum men. However, the four-day program offers 45 papers covering the mechanical-engineering aspects and newest developments for pipelining, drilling, production, refining and petrochemical manufacture.

The program which follows was carefully selected. In the next issue of MECHANICAL ENGINEERING there will appear an account relating how it was done with punch cards.

▶SUNDAY, SEPTEMBER 21

Registration **3:00 p.m.**

Chairman: *W. K. Sutherland*, Public Service Co. of Colorado, Denver, Colo.

"Get Acquainted" Reception
5:00 p.m. to 7:00 p.m.

Reception Chairman: *R. P. Kewley*

Entertainment Chairman: *F. O. Ruud*, U. S. Bureau of Reclamation, Denver, Colo.

Ladies' Activities Chairman: *Mrs. R. C. Hadley*

▶MONDAY, SEPTEMBER 22

Mechanical Design—Session 1
9:00 a.m.

Refining, Gas Products, and Petrochemical—1

Chairman: *M. A. Scheil*, A. O. Smith Corp., Milwaukee, Wis.

Vice-Chairman: *J. V. Parce*, The Stearns-Roger Manufacturing Co., Denver, Colo.

Torispherical Shells—a Caution to Designers, by *G. D. Galletly*, Shell Development Co., Emeryville, Calif. (ASME Paper No. 58—PET-3)

Steady-State Creep Analysis of the Weight Loadings of Furnace Tubes on Multiple Supports, by *J. L. Jacobowitz* and *C. K. Mader*, The M. W. Kellogg Co., New York, N. Y. (ASME Paper No. 58—PET-14)

Production Equipment—Session 2
9:00 a.m.

Drilling and Production—1

Chairman: *W. R. Clarke*, Jones & Laughlin Supply Division, Tulsa, Okla.

Vice-Chairman: *F. H. Poettman*, Ohio Oil Co., Littleton, Colo.

Today's Economy—a Challenge to the Operators and Designers of Oil Fields,[1] by *Harry Pistol*, and *M. E. True*, Humble Oil & Refining Co., Houston, Texas

Electromechanical Tubing Caliper for the Classification of Oil-Field Tubing, by *W. M. Kelly*, Otis Engineering Corp., Dallas, Texas (ASME Paper No. 58—PET-9)

[1] Paper not available—see box on page 122.

Low-Cost Field Compressor Installations—Session 3 (Panel Discussion)
9:00 a.m.

Refining, Gas Products, and Petrochemical—2

Chairman and Moderator: *L. G. Weinecke*, Phillips Petroleum Co., Bartlesville, Okla.

Vice-Chairman: *Taylor MacBelt*, Colorado Interstate Gas Co., Colorado Springs, Colo.

Panel Members and Topic

Automation of Remote Unmanned Compressor Stations, by *R. B. McLaughlin*, Northern Natural Gas Co., Omaha, Neb.

Minimum Practical Housing of Low-Cost Compressor Stations, by *B. J. Thompson*, Warren Petroleum Corp., Tulsa, Okla.

Survey of Operating and Maintenance Expenses for Small Skid-Mounted Compressor Units, by *P. B. Edmondson*, The Atlantic Refining Co., Dallas, Texas, and *H. W. Evans*, Sinclair Oil & Gas Co., Tulsa, Okla.

Comparison of Costs of Skid-Mounted Versus Permanent Mounted Compressor Stations, by *R. E. Evans*, The Stearns-Roger Manufacturing Co., Denver, Colo.

Pipeline Design—Session 4 **9:00 a.m.**

Transportation—1

Chairman: *E. E. Mincheff*, Williams Bros. Co., Tulsa, Okla.

Vice-Chairman: *N. G. Noonan*, Engineering Consultants, Denver, Colo.

Controlling Pipe Stress in Underwater Construction, by *N. H. Roades*, Tennessee Gas Transmission Co., Houston, Texas (ASME Paper No. 58—PET-17)

Technical Development of High-Strength Line Pipe,[1] by *W. A. Saylor*, U. S. Steel Corp., Los Angeles, Calif.; and *A. B. Wilder*, U. S. Steel Corp., Pittsburgh, Pa.

Welcoming Luncheon **12:00 Noon**

Presiding: *V. J. Johnson*, National Bureau of Standards, Boulder, Colo.

Introductions: *R. C. Hadley*, The Stearns-Roger Manufacturing Co., Denver, Colo.

Response: *C. H. Shumaker*, Vice-President, ASME Region VIII, Southern Methodist University, Dallas, Texas

Address: *J. N. Landis*, ASME President

ASME Unfired Pressure Vessel Code, Section 8—Session 5 (Panel Discussion)
2:00 p.m.

Refining, Gas Products, and Petrochemical—3

Chairman and Moderator: *F. R. Campbell*, Colorado School of Mines, Golden, Colo.

Vice-Chairman: *A. A. Woodward*, Public Service Co. of Colorado, Denver, Colo.

Panel Members

G. E. Fratcher, A. O. Smith Corp., Milwaukee, Wis.

R. W. Clark, General Electric Co., Schenectady, N. Y.

C. E. Rawlins, Phillips Petroleum Co., Bartlesville, Okla.

F. S. G. Williams, Taylor Forge & Pipe Works, Chicago, Ill.

L. P. Zick, Chicago Bridge & Iron Co., Chicago, Ill.

E. C. Korten, Hartford Steam Boiler & Inspection Co., Hartford, Conn.

Oil-field Strain-Gage Applications—Session 6 (Panel Discussion) **2:00 p.m.**

Drilling and Production—2

Chairman and Moderator: *M. M. Lemcoe*, Southwest Research Institute, San Antonio, Texas

Vice-Chairman: *B. H. Spurlock*, Colorado University, Boulder, Colo.

Gas Pipeline Control—Session 7
2:00 p.m.

Transportation—2

Chairman: *N. B. LauBach*, Colorado Interstate Gas Co., Colorado Springs, Colo.

Vice-Chairman: *C. H. McCabe*, General Electric Co., Denver, Colo.

Series—Parallel Centrifugal Compressor for Pumping Flexibility,[1] by *R. E. Schuhmann*, Trunkline Gas Co., Houston, Texas

Philosophy of Telecontrol of Reciprocating Gas-Engine-Compressor Units,[1] by *F. V. Long*, Texas Eastern Transmission Corp., Shreveport, La.

Analog Computation of Gas Flow,[1] by *H. A. Larberg*, Panhandle Eastern Pipe Line Co., Kansas City, Mo.

Drilling and Production—Session 8
2:00 p.m.

Materials—1

Chairman: *H. L. Willke*, The National Supply Co., Pittsburgh, Pa.

Vice-Chairman: *F. O. Ruud*, U. S. Bureau of Reclamation, Denver, Colo.

Alumina Ceramics in the Petroleum Industry,[1] by *D. E. Howes*, Coors Porcelain Co., Golden, Colo.

Epoxy Resin Coatings—Factors Influencing Their Selection and Performance, by *C. Jekot* and *A. J. Da Velle, Sr.*, De Soto Paint & Varnish Co., Garland, Texas (ASME Paper No. 58—PET-19)

Toast to Spindletop
6:00 p.m. to 7:00 p.m.

All Conference registrants and their guests are cordially invited, compliments of ASME Rocky Mountain Section.

▶TUESDAY, SEPTEMBER 23

New ASA B31.3 Piping Code Section for Petroleum Refineries—Session 9
9:00 a.m.

Refining, Gas Products, and Petrochemical—4

Chairman and Moderator: *F. S. G. Williams*, Taylor Forge and Pipe Works, Chicago, Ill.

Vice-Chairman: *R. F. Throne*, Public Service Co. of Colorado, Denver, Colo.

Registration

Sunday, September 21, 3:00 p.m. to 7:00 p.m.
Monday, September 22, 7:30 a.m. to 5:00 p.m.
Tuesday, September 23, 8:00 a.m. to 5:00 p.m.
Wednesday, September 24, 8:00 a.m. to 12:00 Noon

Papers by Mail

ONLY numbered ASME papers in this program are available in separate copy form until July 1, 1959. Copies can be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 25 cents to members of ASME, 50 cents each to nonmembers. Papers must be ordered by the paper number listed in this program; otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the Conference.

Panel Members

J. P. Mooney, Humble Oil & Refining Co., Baytown, Texas

R. G. Bateman, The M. W. Kellogg Co., New York, N. Y.

D. J. Bergman, Universal Oil Products Co., Des Plaines, Ill.

H. M. Howarth, Standard Oil Co., Whiting, Ind.

N. J. Rees, Socony Mobil Oil Co., Inc., New York, N. Y.

R. C. Green, Southwest Fabricating & Welding Co., Houston, Texas

H. A. Hilt, The Stearns-Roger Manufacturing Co., Denver, Colo.

W. P. Kliment, Crane Co., Chicago, Ill.

C. C. Martini, Phillips Petroleum Co., Bartlesville, Okla.

Lease Automatic Custody Transfer (LACT)—Session 10 (Panel Discussion) 9:00 a.m.

Drilling and Production—3—Transportation—3

Chairman and Moderator: *F. H. Warren*, Ohio Oil Co., Findlay, Ohio

Vice-Chairman: *W. E. Glenn*, Continental Oil Co., Denver, Colo.

Aspects of LACT From Pipeline Viewpoint, by *H. L. Shatto*, Shell Development Co., Houston, Texas, and *L. S. Wrightsman*, Humble Pipe Line Co., Houston, Texas (ASME Paper No. 58—PET-10)

Panel Members

J. M. Davies, Shell Oil Co., Tulsa, Okla.

O. J. Dillon, Gulf Oil Corp., New Orelans, La.

L. L. Laurence, Black, Sivalls & Bryson, Inc., Oklahoma City, Okla.

J. W. Harris, A. O. Smith Corp., Houston, Texas

L. S. Wrightsman, Humble Pipe Line Co., Houston, Texas

H. L. Shatto, Shell Development Co., Houston, Texas

New Equipment—Session 11 9:00 a.m

Manufacturers—1

Chairman: *C. A. Wiken*, Rockwell Manufacturing Co., Pittsburgh, Pa.

Vice-Chairman: *R. D. Stottlemyer*, National Supply Co., Denver, Colo.

Above-Ground Test Stands for Turbo Drills,[1] by *J. A. Mitchell* and *J. D. Jeter*, Dresser Industry, Inc., Dallas, Texas

A Microscopic Tubing Caliper,[1] by *Jack Kinley*, M. M. Kinley Co., Houston, Texas

Making Engineers More Effective—Session 12 9:00 a.m.

Refining, Gas Products, and Petro-Chemical—5

Chairman: *J. H. Turner*, Standard Oil Co. of Indiana, Chicago, Ill.

Vice-Chairman: *W. M. Richtmann*, Colorado School of Mines, Golden, Colo.

Recruiting the Engineer, by *R. G. Alleman*, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. (ASME Paper No. 58—PET-11)

Evaluation and Development of Technical Personnel, by *W. E. Alexander*, Monsanto Chemical Co., Texas City, Texas (ASME Paper No. 58—PET-8)

Creativity and Brainstorming, by *A. B. Wintringham*, Ethyl Corp., Baton Rouge, La. (ASME Paper No. 58—PET-7)

INDUSTRY LUNCHEONS

Every person attending the Conference is urged to attend one of these luncheons. It is an opportunity to lunch with others of a common field of interest and to meet the working committee in your branch of the industry.

Manufacturers 12:00 Noon

Presiding: *H. L. Norris, Jr.*, Kinzbach Tool Co., Houston, Texas

Materials 12:00 Noon

Presiding: *G. E. Nevill*, Cameron Iron Works, Inc., Houston, Texas

Drilling and Production 12:00 Noon

Presiding: *L. W. Ledgerwood, Jr.*, The Carter Oil Co., Tulsa, Okla.

Refining, Gas Products, and Petrochemical 12:00 Noon

Presiding: *W. O. Long*, The Fluor Corp., Ltd., East Los Angeles, Calif.

Transportation 12:00 Noon

Presiding: *J. E. Green*, Shell Pipe Line Corp., Houston, Texas

Plastic Pipe Symposium—Session 13 2:00 p.m.

Refining, Gas Products, and Petrochemical—6

Chairman: *R. V. Jones*, Phillips Chemical Co., Bartlesville, Okla.

Vice-Chairman: *R. D. Bailey*, Ambler Co., Wheatridge, Colo.

Symposium

Applications and Design of Plastic Pipe in Refineries and Petrochemical Plants

R. L. Knapp, U. S. Rubber Co., Naugatuck, Conn.

G. H. Hunt, III, Tube Turns Plastics, Inc., Louisville, Ky.

A. C. Anderson, A. O. Smith Co., Milwaukee, Wis.

Drilling Equipment—Session 14 2:00 p.m.

Drilling and Production—4

Chairman: *A. A. Ashton*, Continental-Emsco Manufacturing Co., Houston, Texas

Vice-Chairman: *A. B. Neely*, Shell Oil Co., Denver, Colo.

Approach, Parameters, and Interpretation—V1500 Slush Pump, by *W. R. Barry*, Cardwell Manufacturing Co., Wichita, Kan. (ASME Paper No. 58—PET-15)

Fluid Knock in Oil-Field Mud Pumps Due to Separation, by *S. L. Collier*, Mission Manufacturing Co., Houston, Texas (ASME Paper No. 58—PET-5)

How to Get the Most Mud Power at the Bottom of the Drill String, by *R. W. Colebrook*, National Supply Co., Houston, Texas (ASME Paper No. 58—PET-6)

Social Hour 6:00 p.m.

Banquet 7:00 p.m.

Presiding: *R. C. Hadley*, Chairman, Section-Division Conference Arrangements Committee

Remarks and Presentation of Awards: *H. H. Meredith, Jr.*, Chairman, ASME Petroleum Division

Speaker: *Edward B. Wilcox*

Subject: **Communism's Threat to the Oil Supply in the Middle East**

Crude and Products Pipeline Operation—Session 15 2:00 p.m.

Transportation—4

Chairman: *E. A. Slade*, Okan Pipe Line Co., Tulsa, Okla.

Vice-Chairman: *R. C. Stafford*, General Electric Co., Denver, Colo.

Experience and Evaluation of Deep Ground Beds, by *R. L. Bullock*, Interstate Oil Pipe Line Co., Shreveport, La. (ASME Paper No. 58—PET-18)

Mass Metering, by *L. L. Laurence*, Black, Sivalls & Bryson, Inc., Oklahoma City, Okla., and *H. E. Trekell*, General Electric Co., West Lynn, Mass. (ASME Paper No. 58—PET-16)

Materials—Refining and Transportation—Session 16 2:00 p.m.

Materials—2

Chairman: *M. S. Northrup*, Esso Research and Engineering Co., Linden, N. J.

Vice-Chairman: *H. H. Sloane*, Bureau of Reclamation, Denver, Colo.

Static Testing of High-Pressure Piping Components,[1] by *T. G. Moore*, Monsanto Chemical Co., Dayton, Ohio; and *E. J. Opersteny*, Monsanto Chemical Co., Texas City, Texas

Panel Discussion: New Developments in Pressure-Piping Connections

J. W. Squire, Service Pipe Line Co., Tulsa, Okla.

E. C. Rodabaugh, Tube Turns, Louisville, Ky.

H. H. George, Tube Turns, Louisville, Ky.

R. C. Brooks, Cameron Iron Works, Inc., Houston, Texas

▶WEDNESDAY, SEPTEMBER 24

Mechanical Design—Session 17 9:00 a.m.

Refining, Gas Products, and Petro-Chemical—7

Chairman: *F. J. Feely, Jr.*, Esso Research & Engineering Co., Linden, N. J.

Vice-Chairman: *C. E. Withers*, Bureau of Reclamation, Denver, Colo.

Aerodynamic Vibrations of Tall Cylindrical Columns, by *R. C. Baird*, Santa Monica, Calif. (ASME Paper No. 58—PET-4)

Vibration of Vertical Pressure Vessels, by *C. E. Freese*, The Fluor Corp., Ltd., Los Angeles, Calif. (ASME Paper No. 58—PET-13)

Engineering Standards—Session 18 9:00 a.m.

Refining, Gas Products, and Petro-Chemical—8

Chairman: *M. M. Heller*, United Gas Pipe Line Co., Shreveport, La.

Vice-Chairman: *R. J. Skilton*, General Electric Co., Denver, Colo.

Inspection Procedures for Gasoline Plant Oil Heaters, by *Peter von Wiesenthal*, Petrochemical Development Co., New York, N. Y. (ASME Paper No. 58—PET-23)

Company-Wide Standards, an Engineering Viewpoint, by *J. Zaba*, and *Henry Schaefer*, Pan American Petroleum Corp., Tulsa, Okla. (ASME Paper No. 58—PET-1)

Research—Session 19 9:00 a.m.

Drilling and Production—5

Chairman: *H. L. Shatto*, Shell Development Co., Houston, Texas

Vice-Chairman: *C. H. Griffin*, R. L. Manning, Inc., Denver, Colo.

Drilling by Vibration, by *Ralph Simon*, Battelle Memorial Institute, Columbus, Ohio (ASME Paper No. 58—PET-21)

Operational Range of Capacitance Type BS&W Analyzer,[1] by *R. S. Wood*, Gulf Research & Development Co., Pittsburgh, Pa.

A New Analytical Approach to Drill Pipe Breakage, by *J. L. Bogandoff* and *J. E. Goldberg*, Midwest Applied Science Corp., Lafayette, Ind. (ASME Paper No. 58—PET-12)

Symposium: Use of Digital Computers by Gas and Liquid Pipeline Companies—Session 20 9:00 a.m.

Transportation—5

Chairman: *B. D. Goodrich*, Texas Eastern Transmission Co., Shreveport, La.

Vice-Chairman: *D. C. Neithercut*, American Steel & Iron Co., Denver, Colo.

J. T. Manry, III, Tennessee Gas Transmission Co., Houston, Texas

D. W. Bean, Colorado Interstate Gas Co., Colorado Springs, Colo.

PETROLEUM DIVISION COMMITTEE MEETINGS

Committee	*Presiding*	*Date*	*Time*
Refining	W. O. Long	Sat., Sept. 20	10:00 a.m.
Drilling and Production	L. W. Ledgerwood	Sat., Sept. 20	10:00 a.m.
Sections Liaison	O. L. Lewis	Sun., Sept. 21	10:00 a.m.
Press and Publicity (Luncheon)	W. H. Parks	Sun., Sept. 21	12:00 Noon
Transportation	J. E. Green	Sun., Sept. 21	1:30 p.m.
Materials	G. E. Nevill	Sun., Sept. 21	1:30 p.m.
General and Denver Arrangements	Meredith & Hadley	Sun., Sept. 21	3:00 p.m.
Refining	W. O. Long	Mon., Sept. 22	4:30 p.m.
Refining	W. O. Long	Tues., Sept. 23	1:00 p.m.
Transportation	J. E. Green	Tues., Sept. 23	1:00 p.m.
Manufacturers	H. L. Norris	Tues., Sept. 23	1:00 p.m.
Materials	G. E. Nevill	Tues., Sept. 23	1:00 p.m.
Drilling and Production	L. W. Ledgerwood	Tues., Sept. 23	1:00 p.m.
Drilling and Production	L. W. Ledgerwood	Tues., Sept. 23	4:50 p.m.
Executive	H. H. Meredith	Tues., Sept. 23	5:00 p.m.
General & Denver Arrangements (Luncheon)	H. H. Meredith	Wed., Sept. 24	12:00 Noon

J. H. Ferguson, United Gas Pipe Line Co., Shreveport, La.

T. R. Young, Shell Pipe Line Corp., Houston, Texas

W. S. Pickrell, International Business Machines, New York, N. Y.

R. J. Baxter, Gulf Oil Corp., Pittsburgh, Pa.

Well-Servicing Equipment—Session 21
2:00 p.m.

Drilling and Production—6

Chairman: *J. W. Gates*, Well Equipment Manufacturing Corp., Houston, Texas

Vice-Chairman: *J. W. Maly*, Halliburton Oil Well Cementing Co., Denver, Colo.

Designing Features and Performance Characteristics of HT-400 Cementing and Fracturing Pump,[1] by *Cy Jeffords*, *Don Wilson*, and *Frank Bynum*, Halliburton Oil Well Cementing Co., Duncan, Okla.

New Fracturing Header and Discharge System, by *C. A. Pitts*, Dowell, Inc., Tulsa, Okla. (ASME Paper No. 58—PET-2)

Mechanical Design—Session 22
2:00 p.m.

Manufacturers—2

Chairman: *C. R. Neilon*, The National Supply Co., Houston, Texas

Vice-Chairman: *J. W. Maly*, Halliburton Oil Well Cementing Co., Denver, Colo.

Testing Methods for Rubber-Sealing Materials,[1] by *A. F. Rhodes*, The McEvoy Co., Houston, Texas

Improved Characteristics of a Crank-Balanced Pumping Unit, by *J. P. Byrd*, Oilfield Equipment Corp. of Colorado, Denver, Colo. (ASME Paper No. 58—PET-22)

Transportation—Session 23 2:00 p.m.

Materials—3

Chairman: *D. R. Croft*, Transcontinental Gas Pipe Line Co., Houston, Texas

Vice-Chairman: *O. E. Froid*, The Stearns-Roger Manufacturing Co., Denver, Colo.

Studies of the Chemical and Physical Properties of Line Pipe,[1] by *C. E. Rawlins*, Phillips Petroleum Co., Bartlesville, Okla.

Weld Repairs on X-52 Line Pipe,[1] by *R. D. Morel*, Transcontinental Gas Pipe Line Co., Houston, Texas

Mechanical Design—Session 24
2:00 p.m.

Refining, Gas Products, and Petrochemical—9

Chairman: *Lee Van Horn*, The Fluor Corp., Ltd., Los Angeles, Calif.

Vice-Chairman: *Guido Wyss*, Bureau of Reclamation, Denver, Colo.

Design Criteria for Single Internal Vessel Heads,[1] by *G. P. Eschenbrenner* and *J. T. McKeon*, The M. W. Kellogg Co., New York, N. Y.

Report on Strength of Welded Low-Alloy Steel at Elevated Temperature,[1] by *W. B. Hoyt*, The M. W. Kellogg Co., New York, N. Y.

Strength of Thick-Walled Cylinders, by *S. M. Jorgenson*, Foster Wheeler Corp., New York, N. Y. (ASME Paper No. 58—PET-20)

1958 National Power Conference in Boston, Mass., Sept. 28—Oct. 1

A JOINT National Power Conference will be held at the Hotel Statler in Boston, Mass., on Sept. 28 through Oct. 1, 1958. The conference is jointly sponsored by The American Society of Mechanical Engineers Power Division and the American Institute of Electrical Engineers Power Division with co-operating sponsorship by the Electric Council of New England.

Technical papers to be presented will cover most phases of the power field. James N. Landis, President of ASME, will be the speaker at a luncheon on Monday, and L. F. Hickernell, President of AIEE, will be the speaker at a luncheon scheduled for Wednesday, October 1.

Edward H. Barry, General Arrangements Chairman has announced that plant trips to several industrial and power plants in the area have been scheduled. Among the high lights will be the opportunity to inspect a modern aircraft carrier, a missile cruiser, and an atomic submarine.

The technical program follows:

▶SUNDAY, SEPTEMBER 28

Registration 3:00 p.m.

Social Hour for "Early Birds"
4:00 to 6:00 p.m.

Hosts: Boston Sections of ASME and AIEE

▶MONDAY, SEPTEMBER 29

Registration 8:00 p.m.

Session 1—Steam Power Plant Design 9:00 a.m.

Chairman: *George Orrok*, vice-president, Boston Edison Co.

Vice-Chairman: *H. R. Stewart*, New England Power Association, Boston, Mass.

A Look at the Future in Station Design, by *E. H. Krieg*, Stone & Webster Engineering Corp. (ASME Paper No. 58—PWR-4

Relay-Protection Practices in Steam-Power Stations,[1] by *H. C. Barnes*, American Electric Power Co.; *C. S. Murray*, Consolidated Edison Co.; and *V. E. Verrall*, Central Illinois Public Service Co.

Auxiliary Power for Eddystone Station,[1] by *J. A. Adams*, Philadelphia Electric Co.

Luncheon 12:15 p.m.

Speaker: *James N. Landis*, President, ASME

Session 2—Current Thinking in Large Steam Turbine Generator Design 2:00 p.m.

Chairman: *J. D. Waddell*, vice-president, Maine Public Service Co.

Vice-Chairman: *L. O. Dorfman*, Sanderson & Porter, New York, N. Y.

Reporter: *Fisher Black*, editor, *Electrical World*

Modern Large Steam Turbines and Generators,[1] by *C. C. Franck, Sr.* and *J. W. Batchelor*, Westinghouse Electric Corp.

Design Features and Characteristics of Large Steam Turbine Generators, by *S. C. Barton*, *J. A. Massingill*, and *H. D. Taylor*, General Electric Co.

Current Large Steam-Turbine-Generator Design Practice,[1] by *J. J. Fleischmann* and *G. W. Stoats*, Allis-Chalmers Manufacturing Co.

[1] Paper not available—see box on this page.

Buffet Supper 6:30 p.m.

Session 3—Boiler Feed-Pump Drive Applications 8:00 p.m.

Chairman: *Eugene Gordon*, vice-president, West Penn Power Co.

Vice-Chairman: *L. W. Cadwallader*, vice-president, Potomac Electric Power Co.

Reporter: *B. G. A. Skrotzki*, associate editor, *Power*

Pumping Power in the Feed-Water Cycle, by *S. N. Arnow* and *J. L. Allen*, Philadelphia Electric Co. (ASME Paper No. 58—PWR-2)

Integration of Single-Turbine-Driven Feed

Availability of Papers

ONLY numbered ASME papers in this program are available in separate copy form until July 1, 1959. Copies can be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 25 cents to members of ASME, 50 cents to nonmembers. Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the Conference.

Pumps in Large Generator Units,[1] by *S. N. Fiala*, American Electric Power Co.

Evolution of the Boiler Feed-Pump Drive,[1] by *R. A. Baker*, Public Service Electric and Gas Co.

Session 4—Career Possibilities for Young Engineers in the Power Field 8:00 p.m.

Chairman: *William F. Ryan*, past-president, ASME

Vice-Chairman: *Mark Ireland, Jr.*, Newport News Shipbuilding and Dry Dock Co.

The Graduate Engineer in the Power Industry,[1] by *J. H. Keenan*, professor of mechanical engineering, M.I.T.

Expanding Horizons for the Graduate Engineer in Electric Power,[1] by *Gordon Brown*, head, department of electrical engineering, M.I.T.

Power and Growth: The Challenge and the Promise, by *F. A. Kramer*, assistant engineer, Public Service Electric and Gas Co. (ASME Paper No. 58—PWR-7)

Factors Affecting an Engineering Career in the Power Field,[1] by *V. F. Estcourt*, general superintendent of steam generation, Pacific Gas & Electric Co. (ASME Paper No. 58—PWR-6)

▶TUESDAY, SEPTEMBER 30

Registration 8:00 a.m.

Session 5—Nuclear Power and Marine Power 9:00 a.m.

Chairman: *J. P. Den Hartog*, professor of mechanical engineering, M.I.T.

Vice-Chairman: *R. M. Donaldson*, Newport News Shipbuilding and Dry Dock Co.

Nuclear Power

Reporter: *Andrew W. Kramer*, editor, *Power Engineering*

Yankee Atomic Power Plant,[1] by *R. J. Coe*, Yankee Atomic Power Co.; and *W. E. Shoupp*, Westinghouse Electric Corp

A 125-Mw Pebble-Bed Nuclear Power Station,[1] by *R. F. Benenati*, Sanderson & Porter

The Dresden Nuclear Power Station,[1] by *V. A. Elliott, V. D. Dixon*, General Electric Co.; *R. D. Maxson*, Commonwealth Edison Co.; and *J. W. Marryman*, Bechtel Corp.

Enrico Fermi Atomic Power Plant,[1] by *R. W. Hartwell, A. P. Donnell*, and *H. A. Wagner*, Power Development Co.

Marine Power

Performance Tests of a Vertical Steam Generator for Nuclear Power Plants, by *R. L. Coit* and *C. C. Peake*, Westinghouse Electric Corp. (ASME Paper No. 58—PWR-1)

Application of Boiling Water Reactor for Merchant Ship Propulsion,[1] by *Richard L. Schmidt*, atomic power equipment department, General Electric Co.

Social Hour 6:00 p.m.

Hosts: Boston Section, ASME and AIEE

Banquet 7:00 p.m.

▶WEDNESDAY, OCTOBER 1

Registration 8:00 a.m.

Session 6—Power Transmission and Industrial Power 9:00 a.m.

Chairman: *L. J. Brown*, E. I. du Pont de Nemours and Co., Inc.

Vice-Chairman: *J. B. Moore*, Southern California Co.

D-C Transmission—An American Viewpoint,[1] by *G. D. Breuer, M. M. Morock, L. W. Morton*, and *C. A. Woodrow*, General Electric Co.

Operating Experience in the Illinois-Missouri Power Pool,[1] by *T. W. Schroeder* and *E. A. Shultz*, Illinois Power Co.

Industrial Power Is Different, by *R. K. Patterson*, Chas T. Main, Inc. (ASME Paper No. 58—PWR-5)

Trends in Power-Plant Design for Modern Paper Mills, by *T. J. Judge*, International Paper Co. (ASME Paper No. 58—PWR-3)

Luncheon 12:15 p.m.

Guest: *L. F. Hickernell*, President, AIEE

Session 7—Steam Generator Design and Unit Tripping 2:00 p.m.

Chairman: *F. D. Vermiliya*, Sanderson & Porter
Vice-Chairman: *C. W. Maloney*, Stone & Webster Engineering Corp.

Unit Tripping

Five Years' Experience on the Consolidated Edison System With Protection of Turbine Generators and Boilers by Automatic Tripping, by *W. C. Beattie, J. M. Driscoll, P. T. Onderdonk, H. A. Baumon*, and *R. L. Webb*, Consolidated Edison Co. (ASME Paper No. 58—PWR-8)

Steam Generator Design Trends

Reporter: *Alton Kirkpatrick*, Chas. T. Main, Inc.

Design Requirements for Steam Generation With High-Cost Fuels,[1] by *C. F. Hawley*, Riley Stoker Corp.

Modern Steam-Generator Designs,[1] by *D. R. Wilson*, The Babcock & Wilcox Co.

A Preview of Tomorrow's Boilers,[1] by *E. M. Powell*, Combustion Engineering Inc.

Trends in Present-Day Boiler Design, by *D. B. Stewart*, Foster-Wheeler Corp.

Women's Program

▶SUNDAY, SEPTEMBER 28

3:00 to 6:00 p.m. Registration
4:00 to 6:00 p.m. Social Hour for "Early Birds"

▶MONDAY, SEPTEMBER 29

8:00 a.m. Registration
9:00 a.m. Coffee Hour
12:15 p.m. *Luncheon
2:00 p.m. Artist talk and demonstration
6:30 p.m. *Buffet Supper
8:00 p.m. Informal Bridge

▶TUESDAY, SEPTEMBER 30

8:00 a.m. Registration
9:30 a.m. Bus tour historic places and North Shore luncheon
Bus back to hotel
6:00 p.m. *Social Hour
7:00 p.m. *Banquet

▶WEDNESDAY, OCTOBER 1

8:00 a.m. Registration
10:30 a.m. Lecture and Luncheon, M.I.T. Faculty Club, Cambridge, Mass., transportation from hotel and return
12 Noon–5 p.m. *Luncheon

* Main conference events to which all are cordially invited.

The Wright Brothers' Accomplishments to Be Commemorated in NYU Hall of Fame

NYU Senate waives 25-year eligibility rule to permit nomination of Orville Wright

THE Senate of New York University, in an unprecedented action, has waived the 25-year eligibility rule to permit the nomination of Orville Wright, Hon. Mem. ASME, in the 1960 elections of the Hall of Fame for Great Americans.

Ralph W. Sockman, director of the national shrine at NYU's Bronx campus, points out that the waiver pertains only to Orville Wright and has been granted so that busts of him and his brother Wilbur might be installed together in the Hall of Fame's open-air colonnade. As in previous elections, other candidates for the honor must have been dead at least 25 years.

Wilbur Wright, who died in 1912, was chosen for enshrinement in 1955. He and Orville invented the power-driven airplane and made the first sustained flights at Kitty Hawk, N. C., on Dec. 17, 1903.

Dr. Sockman said that many persons had petitioned the Hall of Fame to waive the 25-year rule for Orville Wright.

"These persons," he reported, "felt that inasmuch as the accomplishments of Wilbur and Orville Wright are indivisible, it would not be in keeping with historical fact to acknowledge one without the other for posterity."

The Wright brothers, who were born in Dayton, Ohio, took turns in piloting the 1903 flights. The first successful flight was made by Orville and lasted 12 seconds. The fourth and longest flight of the day, made by Wilbur, lasted 59 seconds.

Orville Wright died in 1948. Under the Hall of Fame's 25-year rule he would not have been eligible for nomination until 1975.

Hall of Fame elections are held every five years. The next one will take place in the summer of 1960. The public may place in nomination the names of distinguished persons (the candidates must have been American citizens, either native-born or naturalized) between April 1, 1959, and April 30, 1960. The nominees will then be considered by the shrine's College of Electors, which has a membership of approximately 120 prominent persons representing the 48 states.

Thus far 86 men, including George Westinghouse, 1910 ASME President, and women have been elected to the Hall of Fame, which was originated at the turn of the century by Dr. Henry Mitchell MacCracken, then chancellor of New York University. Busts of these men and women, executed by noted sculptors, are contained in a winding colonnade that stands on high ground overlooking the Harlem and Hudson rivers and facing the New Jersey Palisades.

1958 Power Show Plans Forecast Industrial Upturn

ASME exposition at New York Coliseum, Dec. 1–5, to stress improved power generating and plant-service equipment

MANUFACTURERS of industrial equipment foresee a continuing advance in the market for machinery over the next two years and their confidence is finding early expression in the foundation work on the 23rd National Exposition of Power and Mechanical Engineering, which opens at this year's end.

The Exposition will be staged under the auspices of The American Society of Mechanical Engineers, in the New York Coliseum, December 1 to 5.

Space reservations and blueprints of exhibits on file with the management in July show a substantial increase in the number of displays of large and heavy equipment as compared to 1956.

The basic requirement of retarded industries in realizing recovery projects is more efficient power supplies and better integration of the facilities used in manufacturing plants of every kind. A comprehensive presentation of improved power generating and plant-service equipment is the purpose of the Exposition, which will include apparatus for the distribution of heat and electricity, as well as every other means for plant operation, whatever the product may be.

Exhibitors are in agreement that the new-model movement that is in prospect for nearly all industries will begin with a wholesale retooling and frequent enlargement of factories. Supporting this view are announced plans for expansion of facilities by public utilities in widely scattered areas, as well as a back-log of orders for considerable heavy industrial equipment.

Typical of this biennial display, exhibits will be gathered from 20 or more states, along the eastern seaboard, from the highly industrialized Mid-West, as well as from distant states such as Minnesota, Oklahoma, California, and Texas. Attendance of manufacturing executives, plant managers, and engineers from all parts of the American continent and many foreign countries is expected to account for a total attendance of 40,000 or more during the week.

The Power Show continues under the management of the International Exposition Company, 480 Lexington Avenue, New York 17, N. Y. E. K. Stevens is the manager of the Exposition.

MEETINGS OF OTHER SOCIETIES

Aug. 19–22

American Institute of Electrical Engineers, Pacific general meeting, Senator Hotel, Sacramento, Calif.

Sept. 1–9

International Association for Analog Computation, second meeting, Strasbourg, France.

Sept. 1–13

United Nations, international conference on peaceful uses of atomic energy, Geneva, Switzerland.

Sept. 2–6

Pan-American Federation of Engineering Societies, convention, Montreal, Canada.

Sept. 3–5

Cryogenic Engineering Conference, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 3–10

International Association for Cybernetics second international conference, Namur, Belgium.

Sept. 7–11

World Power Conference, sectional meeting. Montreal, Canada.

Sept. 7–12

American Chemical Society, fall meeting, Chicago, Ill.

Sept. 8–13

International Council of the Aeronautical Sciences, first international congress in the aeronautical sciences, Madrid, Spain.

Sept. 12

Society of Plastics Engineers, Inc., regional technical conference, St. Clair Inn, St. Clair, Mich.

Sept. 15–18

American Rocket Society, Inc., fall meeting, Statler Hilton Hotel, Detroit, Mich.

Sept. 15–17

Technical Association of the Pulp and Paper Industry, fundamental research conference, Queen Elizabeth Hotel, Montreal, Quebec, Canada.

Sept. 15–19

Instrument Society of America, automation conference and exhibit, Philadelphia Convention Hall, Philadelphia, Pa.

Sept. 16–20

Société des Radioélectriciens, international conference on nuclear electronics, UNESCO House, Paris, France.

Sept. 21–24

American Institute of Chemical Engineers, national meeting, Hotel Utah, Salt Lake City, Utah.

(For ASME Coming Events, see page 135)

U. S. and Canada Hosts for Engineers' Meetings

DURING September, 1958, there will be held in Canada and the United States a series of international meetings of prime importance to engineers. The meetings and tours are arranged in series to permit attendance at all events without conflict.

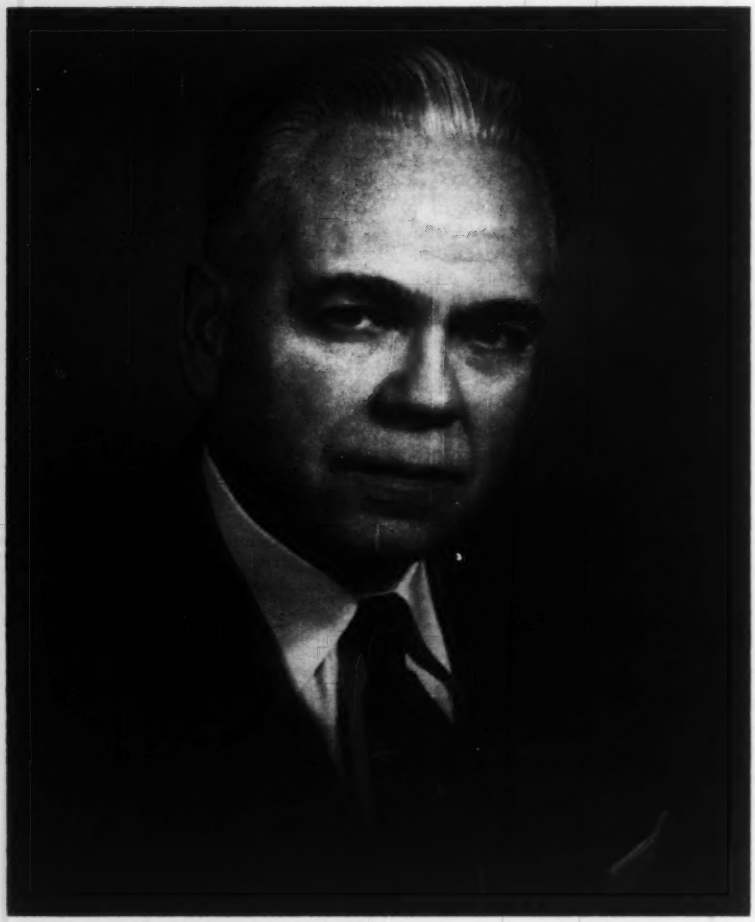
This unique "package" of meetings will attract important engineers and scientists from most countries of the world. Seldom if ever in the past has there been such an opportunity for United States' engineers, and their organizations, to meet at home and, to a limited extent be host to, so many colleagues from abroad. The package meetings and dates are:

September 3–6, Montreal, Canada: Fifth Convention of the Pan American Federation of Engineering Societies (UPADI) includes sessions on engineering education and Pan American Standards.

September 7–11, Montreal, Canada: Sectional Meeting of the World Power Conference.

September 11–14, Study Tour to St. Lawrence River Navigation and Power Projects, to Niagara Falls, to the Nuclear Power Station at Shippingport, Pa., and to New York City.

September 15–20, New York, N. Y., Statler-Hilton Hotel, Sixth International Congress on Large Dams.



Glenn Barton Warren Nominated for ASME President, 1958–1959

ASME OFFICERS Nominated for 1958–1959

DURING the 1958 Semi-Annual Meeting of The American Society of Mechanical Engineers in Detroit, Mich., June 15–19, Glenn Barton Warren, vice-president and consulting engineer—Turbine Division, General Electric Company, Schenectady, N. Y., was nominated by the National Nominating Committee for the office of President of the Society for the year 1958–1959.

Regional Vice-Presidents named by the Committee to serve for a two-year term on the Council of ASME were: Gordon R. Hahn, New York, N. Y., Region II; John W. Little, Birmingham, Ala., Region IV; Thomas J. Dolan, Urbana, Ill., Region VI; and Harold Grasse, Kansas City, Mo., Region VIII. C. H. Coogan, Jr., Storrs, Conn., was nominated to serve a one-year term as Vice-President, Region I.

Directors named by the Committee to serve for a four-year term were the following: Richard G. Folsom, Troy, N. Y., and Arthur M. Perrin, Fairview, N. J.

Members of the Committee making the nominations were: R. M. Scott, representing Region I; J. L. O'Neill, Region II; G. R. Leavitt, Region III ; K. R. Daniel, Region IV; A. B. Heiberg, Region V, *chairman;* C. A. Davis, Region VI, *secretary;* L. C. Koke, Region VII; R. B. Kinzbach, Region VIII; R. M. Johnson, *Codes and Standards;* J. H. Davis, *Technology;* and Robert Nelsen, *Administrative*.

Election of ASME Officers for 1958–1959 will be held by letter ballot for the entire membership, Sept. 23, 1958.

GLENN B. WARREN

GLENN BARTON WARREN, the presidential nominee for 1958–1959 of The American Society of Mechanical Engineers, is a General Electric Company vice-president and is the consulting engineer—Turbine Division, with headquarters in Schenectady, N. Y. He was elected vice-president in December, 1952, having previously served as division general manager.

A native of Rich Hill, Mo., Mr. Warren attended public schools in Girard, Kan., and then studied at the University of Wisconsin, where he received a BS degree in mechanical engineering in 1919. That same year he joined the General Electric Company on the engineering-test program.

Based on work done with W. E. Blowney culminating in an important ASME paper, "The Increase in Thermal Efficiency Due to Resuperheating in Steam Turbines," a master's degree in mechanical engineering was granted Mr. Warren by the University of Wisconsin in 1924.

From 1921 to 1931, Mr. Warren was in charge of research relating to steam-flow elements in turbines at the Schenectady Works. Many of the theories which were developed during those ten years laid the foundation for today's modern turbine design.

In 1931 he was appointed designing engineer for the large turbine department.

Between 1933 and 1944, he designed the main marine propulsion turbine machinery which was most widely applied in combat vessels of the U. S. Navy. Mr. Warren was responsible, along with associates, during 1940–1945, for the design and development of the axial-flow aircraft gas turbines made by General Electric for the U. S. Air Corps. Most of the present United States aircraft-propulsion turbines have grown out of this development.

Mr. Warren has held such major posts with General Electric as designing engineer for the combined turbine and generator engineering departments, and manager of engineering for the Turbine Division. He was named general manager for the Division in 1949 and was subsequently elected a General Electric Company vice-president.

In December, 1956, Mr. Warren was appointed consulting engineer—Turbine Division to help provide the engineering skill and leadership needed to meet the nation's rapidly expanding electrical power requirements.

In the newly created post, Mr. Warren is devoting full time to accelerating the technical progress of industry's basic power unit, the turbine generator. He is responsible for formulating and establishing long-range engineering and product plans for all departments of the Company's Turbine Division, as well as for conducting a continuous audit of all related engineering activities.

In 1948, Mr. Warren received a certificate of commendation from the Navy for "outstanding service to the United States Navy during World War II."

He holds the 1946 General Electric Coffin Award and in 1951 was presented the ASME Medal, one of the Society's highest honors, for "leadership in the science and art of turbine design." He was presented with the University of Wisconsin's citation for engineering achievement in 1952. He holds an honorary DS degree from Union College which he received in 1956.

He has written or coauthored more than 30 papers, mostly on technical subjects, and holds 47 patents dealing mainly with turbines.

Mr. Warren has been a member of ASME since 1924 and was elected a Fellow in 1946. He served on the Schenectady Section Executive Committee from 1924 to 1929, was chairman of the Program Committee in 1925, and chairman of the Section in 1928. He has been active in the Society's national affairs, having been on the Meetings Committee from 1945 to 1950 and its chairman in 1949; on the Executive Committee of the Power Division from 1946 to 1951 and its chairman in 1951; a member of the Honors Committee in 1952, of the Organization Committee from 1952 to 1955, and the 75th Anniversary Committee from 1945 to 1955. He is now serving as the first national Director representing the Board on Technology and related activities in a term running from 1955 to 1959.

In addition to ASME he is a member of many other professional societies and organizations including the National Society of Professional Engineers, American Power Conference Turbine-Generator Division Committee, American Society of Naval Engineers, Society of Naval Architects and Marine Engineers, American Atomic Industrial Forum, and Jet Pioneers Association of America.

He was a member of the Visiting Committee for the mechanical-engineering department of the Massachusetts Institute of Technology, 1955 and 1956, and served on the board of directors of the Associated Industries of New York State, Inc., during 1955 and 1956.

In the Schenectady community he is a member of the Chamber of Commerce, a trustee for the Children's Home, one of the founders and a vice-president of the Senior Citizens Center, a member of the Consistory of the First Dutch Reformed Church, and is a member of the Schenectady Bureau of Municipal Research. From 1954 to 1957 he served on the board of directors of the Schenectady Trust Company.

Nominated for Regional Vice-President to Serve Two-Year Term

Charles H. Coogan, Jr.

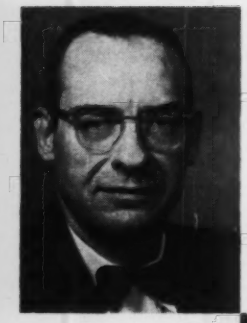
CHARLES HENRY COOGAN, JR., who is professor and head of the mechanical-engineering department at the University of Connecticut, Storrs, Conn., and who has been nominated to serve for one year as Vice-President of ASME, Region I, was born April 2, 1908, in Boston, Mass. He is completing the unexpired term of C. E. Crede. He was educated in the public schools of Boston. He was graduated from Tufts College in 1930 with the BS degree in mechanical engineering, magna cum laude. He attended the Harvard University Graduate School of Engineering and was awarded the MS (Mechanical) degree in 1931. In 1937, he was awarded the professional ME degree by the University of Pennsylvania.

He is a registered professional engineer in the State of Connecticut, a member of the Connecticut State Board of Registration for Professional Engineers and Land Surveyors, and currently is its secretary.

Initial engineering experience was gained as a designer during vacation periods while in college and, in 1930, with Buerkel and Company, Inc., consulting engineers and contractors, Boston.

In 1931, he was appointed instructor in mechanical engineering at the Towne Scientific School of the University of Pennsylvania. In 1942, he became an assistant professor at the University of Connecticut and, in 1947, head of the mechanical-engineering department. In 1948 he was promoted to the rank of full professor.

Several of his papers on jet pumps and heat transfer to ground coils have been published in the ASME publications.

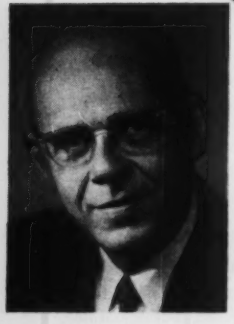


Charles H. Coogan, Jr.

Gordon R. Hahn

John W. Little

Thomas J. Dolan



Harold Grasse

He has conducted research in the field of heat transfer and has authored several experiment-station bulletins in this field. He also wrote the chapters on thermodynamics and the heat pump in the American Society of Refrigerating Engineers Data Book as well as served as associate editor of Section One on fundamentals of this same volume. He has authored numerous articles in the technical literature and has delivered many lectures before professional societies.

During his 27 years of teaching, he has found time to serve as consultant to numerous industrial concerns in the fields of instrument design, heat transfer, and fluid flow.

He was appointed, in 1955, a member of the original Connecticut Advisory Committee on Engineering Scientific and Specialized Personnel of the Selective Service and served until 1957. He also is a member of the Connecticut State Civil Defense Shelter Advisory Committee.

He was recently awarded a certificate by the Connecticut Society of Professional Engineers for his contributions to the education of students for the profession.

He joined the Society as a student member at Tufts, and served as Treasurer of the Student Branch, became a Junior Member in 1931, and a Member in 1941. He has served as Junior Adviser to the Philadelphia Section and as Honorary Chairman of the University of Pennsylvania Student Branch; member, vice-chairman, and chairman of the National Membership Development Committee; member of the Board on Membership; and chairman of the General Arrangements Committee for the Fall Meeting in 1957. He also is serving on the joint ASME-AIChE National Heat Transfer Conference Planning Committee, and is chairman of the ASME Technical Committee on the Teaching of Heat Transfer.

He is also a member of the American Society of Refrigerating Engineers, The National Society of Professional Engineers, The American Society for Engineering Education, Sigma, Xi, Tau Beta Pi, Tau Sigma (Honorary Member), Phi Kappa Phi, and Sigma Pi Sigma.

Gordon R. Hahn

Gordon Rutan Hahn, who has been nominated to serve for two years as Vice-President of The American Society of Mechanical Engineers, Region II, is assistant chief mechanical engineer, Gibbs and Hill, Inc., New York, N. Y.

Mr. Hahn was born May 28, 1906, in Nutley, N. J. He received an ME degree in 1927 and an MS degree in 1941 from Stevens Institute of Technology. In 1927, he joined the New York Edison Company, a predecessor company to the Consolidated Edison Company of New York, as a power-plant tester. After two years on the steam side, he spent ten years on the electrical side, on station and system operation. In 1939, he returned to the steam side and in 1946 became superintendent of the Hudson Avenue Electric Generating Station. The following year he entered the Executive Development Program and spent time in the construction and engineering departments. In 1953, he became general superintendent of the Astoria Electric Station and Gas Plant, which was the position he held when he resigned, in 1957, to become assistant chief mechanical engineer of Gibbs & Hill, Inc., Consulting Engineers.

Since 1941, he has been associated with Stevens Institute of Technology in the graduate school and is currently a visiting professor. He lectures alternately on steam power plants one year and on steam power plant economics the next year.

He has presented technical papers before the ASME, AIEE, and ISA.

He is a member of Pi Tau Sigma and Sigma Xi.

In 1947 he became a member of ASME and has been active in Society affairs since. In the Metropolitan Section, he has been a member of the Executive Committee; secretary, 1955–1956; and chairman, 1956–1957. He has served in Region II as chairman, Student Branch Committee, 1948–1952; chairman, Membership Development Committee, 1952–1953; Junior Delegate, Regional Delegates Conference, 1955; and Speaker, RDC, 1956. In 1954, he was chairman of the national Membership Development Committee and on the National Agenda Committee he served first as a member in 1956–1957; and subsequently as vice-chairman, 1957–1958; and chairman, 1958–1959.

Mrs. Hahn also takes an active interest. She is presently National Treasurer of the Woman's Auxiliary to the ASME.

John W. Little

John Wesley Little, who has been nominated to serve for two years as Vice-President of The American Society of Mechanical Engineers, Region IV, is president of the Goslin-Birmingham Manufacturing Company, Birmingham, Ala.

Mr. Little, a 49-year-old executive, is a native of Alabama. Born and educated in the State, his career has been with one company. In 1929, he was employed by

Goslin-Birmingham as a draftsman-engineer. He rose in 1937 to the position of chief engineer and, in 1947, was made vice-president in charge of engineering and operations, and, in 1957, became president of the company. He holds nine patents dating back to 1948.

In 1946, he joined the Society and in the Birmingham Section he was a member of the Executive Committee, 1950–1955; secretary-treasurer, 1949–1950; vice-chairman, 1951–1952; and chairman, 1952–1953. In 1953, he was elected Junior Delegate to the Regional Delegates Conference and was elected that year to serve as Speaker for the 1954 RDC. He was chairman of the National Agenda Committee in 1957 after having served on the NAC from 1954 to 1957.

Mr. Little also is a member of the American Foundrymen's Society, American Welding Society, American Society for Metals; and was president, in 1956–1957, of Birmingham Engineers' Club.

He has played an active part in his community as well. He has been a City Councilman in Homewood, Ala., 1948–1952; a member of the board of directors, Industrial Health Council; and a member of the Birmingham Executives Club and Birmingham Chamber of Commerce.

Thomas J. Dolan

THOMAS JAMES DOLAN, who has been nominated to serve for two years as Vice-President of The American Society of Mechanical Engineers, Region VI, is professor and head of the department of theoretical and applied mechanics at the University of Illinois, Urbana, Ill. Professor Dolan received his BS in civil engineering, with high honors, in 1929, and his MS in civil engineering, in 1932, from the University of Illinois. He is a member of the following honorary and professional societies: Phi Eta Sigma, Chi Epsilon, Tau Beta Pi, Bronze Tablet, Sigma Xi, Theta Tau, ASME, ASTM, SESA, and ASEE. He was born in 1906, in Chicago, Ill.

Professor Dolan was an instructor at the University of Illinois from 1929 to 1937; assistant professor, 1937–1941; associate professor of theoretical and applied mechanics, 1941–1945; research professor, 1945–1952; and professor and head of the department of theoretical and applied mechanics since December, 1952. On leave of absence during the war, he served as Captain in the U. S. Army Ordnance Department from 1942 to 1945 in charge of gun-tube manufacturing and of subcontracting at the Watertown (Mass.) Arsenal, and also was a member of the Arsenal's specification board.

He is the author of several University of Illinois Engineering Experiment Station Bulletins and of about 100 articles and reports in various technical publications. He has done research work on railroad equipment, fatigue of metals, photoelastic stress analysis, expansion joints for concrete pavements, properties of steels, pressure vessels, bolted joints, and machine frames. Some of his duties include supervision of co-operative research programs with the Air Force, Navy, Pressure Vessel Research Committee, and others. Also, he serves as a consultant to several large corporations.

Professor Dolan was invited by the Swedish National Committee for Mechanics and participated in a special conference on fatigue of metals in Stockholm, 1951; during this trip, he studied the research conducted by 22 European laboratories.

Since he joined the Society in 1936, he has participated in many ways. He served as chairman of the Central Illinois Section in 1949. He contributed four sections of the "ASME Metals Engineering Design Handbook," 1953. He has taken an active part in the work of the Metals Engineering Division and served on the Organizing Committee of the International Conference on Fatigue, 1953; and sponsor on Mechanical Properties of Materials, Applied Mechanics Division, 1952–1958.

He also has taken a major part in other professional societies. He was president of the Society for Experimental Stress Analysis in 1952; he is a member of ASTM Committee E-9 on Fatigue, serving as chairman of the Research Subcommittee, and is a member of the Administrative Committee on Papers and Publications of ASTM.

Professor Dolan has served on several committees of the National Research Council, the Research and Development Board, as a consultant to the National Science Foundation, and on special technical committees of ASM, SAE, PVRC, and SESA.

In 1952, he received the R. L. Templin Award and in 1954 the C. B. Dudley Medal from ASTM for his outstanding papers on the development of new and useful methods of testing and for meritorious research on engineering materials.

Harold Grasse

HAROLD GRASSE, nominee for Vice-President of The American Society of Mechanical Engineers, Region VIII, for two years, was born in Spartanburg, S. C., Oct. 31, 1911. In 1917, his family moved to Kansas City, Mo., where he was educated in the public schools. He was graduated from the University of Kansas in 1936 with a BS degree in mechanical engineering. While at college he was active in the ASME Student Section and, in 1935, won second place in the student-paper competition at the Northern Tier Student Conference.

Following graduation, he worked as a manufacturers' agent until he became affiliated with Black & Veatch in 1938 where he has been concerned chiefly with steam central station design. From 1938 to 1944 he worked on specifications, estimates, equipment selection, and piping design. Then he was in charge of mechanical drafting and the piping-design section. He advanced successively to project engineer and, in 1956, he was made principal engineer.

As a result of an interesting design problem, Mr. Grasse presented a paper, "A Solution to Inadequate River Cooling Water Supply," at the 1953 Annual Meeting of Region VIII, in New Orleans. "A Comprehensive Training Program for Power-Plant Personnel" was written after conducting a five-month seminar instructing and training shift supervisors and operators in the design features and operating procedures of a new central station on which he was project engineer. This paper was presented at the Semi-Annual Meeting of the Society in Boston, in 1955.

During World War II he was commissioned a Lieutenant in the U. S. Naval Reserve and specialized in ship-salvage operations and deep-sea diving.

Mr. Grasse joined ASME in 1937 and from 1940 to 1952 served on the Executive Committee of the Kansas City Section, as chairman during last year. He was a member of the Local Affairs Committee in 1952 for the Petroleum Division Conference and local chairman in 1954 for the Oil and Gas Power Division Conference.

From 1950 to 1952, he was a member of the Regional Student Section Committee and its chairman in 1953. He was a Delegate to the Regional Administrative Committee from 1950 to 1953. For the next five years he served as secretary to the Vice-President of Region VIII.

He initiated the Kansas City Industrial Forum Program as a service to student mechanical engineers and has been a judge of the Science Fair for several years.

He is a member of the Missouri Society of Professional Engineers, NSPE, and the Engineers' Club of Kansas City. He is a registered professional engineer in the State of Missouri.

In his community of Leawood, a suburb of Kansas City, he has been City Street Commissioner for two years and is a member of the Commission on Highway Planning in Johnson County, Kan.

Nominated for Director to Serve Four-Year Term

Arthur M. Perrin

Richard G. Folsom

ARTHUR M. PERRIN

ARTHUR MITCHELL PERRIN, who has been nominated to serve as a Director of The American Society of Mechanical Engineers for a four-year term, has just completed a term as chairman of the Metropolitan Section, 1957–1958.

Born Aug. 12, 1907, in Brooklyn, N. Y., Mr. Perrin attended Pratt Institute and is a registered professional engineer (State of Illinois). One of the founders of National Conveyors Company, Inc., in 1933, has been president since 1942.

Since joining the Society in 1933, his activities have been continuous and extensive. He was a member of the Management Division's Executive Committee for a period of five years, and was the Division's chairman in 1953. He was a member of the Metropolitan Section Executive Committee for a period of three years and was its chairman in 1957–1958. He was chairman, Region II, Membership Development Committee in 1957. He was the Region II representative at the Region Delegates Conference in 1957 and 1958. He was the ASME representative on the Gantt Medal Board of Award, from 1954 to 1958. In May, 1958, he was awarded the grade of Fellow of ASME.

He is an inventor. He is author of a number of papers notably in the fields of pneumatic conveying and management. Mr. Perrin is president of the Bergen County Chapter for the Society for Advancement of Management, and since 1948, has been a member of the Council for International Progress in Management. He was elected president of the Candlewood Knolls Association in 1948 (a civic organization); a member of the Downtown Athletic Club, New York City, and the Knickerbocker Country Club, Tenafly, N. J. Mr. Perrin is a member of the Advisory Board of The First National Bank of Jersey City, N. J.

Mr. Perrin was awarded the Certificate of Co-operation, Jan. 19, 1955, by the Foreign Operations Administration of the United States, Washington, D. C., for his accomplishments during a visit to Italy, in 1954, as a member of the Italian Industrial Management Team. The visit was made under the auspices of the National Government to extend to European management the opportunity of discussing American management methods and their application to the European Program for Economic Development. Mr. Perrin has continued this work, and this year he has met with Japanese and German study teams visiting the United States under the auspices of the International Co-operation Administration of the United States.

Mr. Perrin is a contributing author of the "Material Handling Handbook" published 1958 by the Ronald Press Company. He was chairman of the "Ten Year Progress in Management Report" (May, 1953, *Transactions of ASME*); and associate editor for the "Salvage Manual for Industry," published by the War Production Board in September, 1943.

Mr. Perrin is a guest lecturer at Fairleigh Dickinson University, and he has presented many talks at ASME, SAM, and AMA meetings.

Richard G. Folsom

RICHARD GILMAN FOLSOM, who has been nominated to serve as a Director of The American Society of Mechanical Engineers for a four-year term, took office March 1, 1958, as president of Rensselaer Polytechnic Institute. Born in Los Angeles, Calif., Feb. 3, 1907, he was educated at the California Institute of Technology. In 1928 he received a BS degree and an MS in 1929 and a PhD in 1932.

He came to RPI from the University of Michigan at Ann Arbor, where he had been professor of mechanical engineering and director, Engineering Research Institute, for five years. He went to the University of Michigan from the University of California, Berkeley. At California, during the period from 1933 to 1947, he rose through academic ranks from instructor to professor of mechanical engineering and, from 1947 to 1953, was chairman of the Mechanical Engineering Division. During 1952 and 1953, he was also director of the University's Mechanical Engineering Laboratories.

Dr. Folsom has made extensive contributions to educational and scientific publications. He is a member of many professional and educational societies and is active on committees of those organizations interested in improvement of engineering, science, and higher education.

His participation in ASME activities includes membership on the Professional Division's Executive Committee and the Educational Advisory Committee. He is research secretary for the Hydraulic Division, and Hydraulic Division representative on the Research Planning Committee. Also, he is a member of the Research Committee on Fluid Meters and the Power Test Codes Committee No. 8 on Centrifugal Pumps.

Dr. Folsom is on the ECPD Education and Accreditation Committee; and is a consulting editor for the McGraw-Hill Series in Mechanical Engineering.

Nebraska Leads the Nation!!

THE official opening of the ASME Member Gifts Campaign organized for raising funds for the new United Engineering Center, was announced to ASME members in the United States in the letter of May 9, 1958, from William F. Ryan, Chairman of the ASME Member Gifts Committee and past-president ASME.

The first gifts and pledges received by Headquarters through the official campaign were from the Nebraska Section. The initial contributions were all from Lincoln.

The quota for ASME member gifts is $800,000, our Society's part of the $3 million to be raised through contributions from individual society members. The Member Gifts Campaign is the opportunity for everyone who is interested in the advancement of engineering to do his part. The remaining $5 million of the $8 million needed to construct the new Center is to be sought from industry.

The American Society of Mechanical Engineers salutes Nebraska and extends its special congratulations to the city of Lincoln!

Madrid Site of First International Aeronautical Congress, September 8–13

ASME Members to take important part in 20-nation conference

HIGH-SPEED aircraft, guided missiles, satellites—all are currently in the news throughout the world—have engendered international discussion on many levels. Against this background, the men behind the news—the world's foremost scientists and engineers whose ingenuity and training have brought about these advances—have inaugurated the First International Congress of the Aeronautical Sciences. Site of the Congress will be the Instituto Nacional de Prevision, Alfonso XI, #1, Madrid, Spain, from September 8–13. The Congress, planned by the International Council of the Aeronautical Sciences (ICAS), will make possible the exchange of aero and astronautic ideas among scientists from more than 20 nations.

Theodore von Karman, Mem. ASME and first honorary president of ICAS, will preside. At the opening session of the Congress, he will deliver the initial Daniel and Florence Guggenheim International Memorial Lecture. The same session will hear Pedro Blanco give the Juan de la Cierva Lecture.

The comprehensive program of technical sessions promises informed discussion of each of the following subjects: Hypersonic flow, structures and aeroelasticity, heat transfer and heat barrier, jet engines and noise, navigation and guidance, boundary-layer control, VTOL/STOL, heat resistant materials, human engineering, telecommand, and telemetering.

Of the 43 papers scheduled for presentation at the Congress, 13 will be presented by Americans representing government agencies, educational institutions, and industry. ASME Members, E. R. G. Eckert, University of Minnesota; William Littlewood, American Airlines, Inc.; N. J. Hoff, Stanford University; and C. S. Draper, Fellow ASME, M.I.T.; are among the U. S. representatives on the Congress program.

Registration fee for the Congress is $5, those who wish to attend should direct inquiries to S. Paul Johnston, Director, The Institute of Aeronautical Sciences, 2 East 64th Street, New York 21, N. Y.

UET Grants Advance 26 Projects

ASME Properties of Steam Project among important major research projects

CONTINUATION of studies that are steadily reducing the cost of reinforced concrete construction; another study that will eliminate uncertainties in the properties of high-temperature and high-pressure steam for power generation, whether from coal, oil, or atomic heat; still another aimed at reducing our huge annual losses from metallic corrosion—these are just a few of the important research projects that are receiving Engineering Foundation support.

At a meeting held recently in New York, the Engineering Foundation announced grants of $71,500 to advance research in the 1958-1959 fiscal year. These new allocations will further 26 projects that will also receive nearly $1 million outside support from industry. The projects, to which funds have been allocated, represent all the important branches of the engineering profession. They are being carried out in university, government, and industrial laboratories all over the country under sponsorship of the major engineering societies.

Column Research

Typical of the studies receiving Engineering Foundation support is the program of the 12-year-old Column Research Council. Organized by the American Society of Civil Engineers to conduct research on structural columns, the Council has produced findings that permit greater economy of design without sacrifice of safety. In addition to its regular program, the Council is currently preparing a guide to specifications for metal columns and other members with capacity limited by stability. The guide will correlate the results of the extensive analytical and experimental work done by the Council with other available data.

Properties of Steam

Another important project receiving one of the new grants is a study of the Properties of Steam, which is under the sponsorship of The American Society of Mechanical Engineers. The Steam Properties Program was established in 1954, reviving an earlier ASME study completed in 1934. The work is set up as an eight-part program, which has the ultimate aim of extending the present working steam-table range to 1500 F and 15,000 psia. The high pressures and temperatures used today in steam for both power generation and chemical processing emphasize the need for extending the tables, which have been in use since 1934. Five of the projects are under way at California Institute of Technology, Brown University, and Georgia Institute of Technology. The program functions within an international framework.

Brittle Material

Also approved for a grant is the Comminution Project of the American Institute of Mining, Metallurgical and Petroleum Engineers. This project, which has been under investigation at Massachusetts Institute of Technology since 1951, is attempting to solve problems associated with the size reduction of brittle materials. It has been found that the cause of cracking of such materials is not chemical and that, in many cases, samples are cracked by heating alone. However, heat is not necessarily the only cause of intergranular crushing. Future work on the project will be aimed at obtaining a better picture of the intergranular bonds in minerals and rocks.

Wave Research

The destructive effects of wave action on Fire Island and the south shore of Long Island, N. Y., this past winter dramatically underscore the importance of another project that continues to receive Engineering Foundation support. The Council on Wave Research is an independent program set up to help combat the universal problem of eroding beaches. In its eight years of existence the Council has sponsored six conferences on different phases of coastal engineering. The

(*Continued on page 133*)

Conducted for the National Junior Committee

N. J. VIEHMANN

JUNIOR FORUM

Junior Session Held During ASME Semi-Annual Meeting in Detroit

By Edward F. Hoelscher[2]

THE general theme for the various Junior Sessions conducted throughout this year is "The Young Engineer and His Future." On June 17, at the Semi-Annual Meeting of the Society held in Detroit, there took place, under the sponsorship of the National Junior Committee, a panel discussion of the topic: "Who Controls Your Future?" The panelists, all of whom are Associate Members of ASME, included: Thomas J. Feaheny, Product Planning Analyst, Ford Division of Ford Motor Company, Dearborn, Mich.; Conrad M. Ladd, Mechanical Engineer, Atomic Power Development Associates, Inc., Detroit, Mich.; and Robert I. Walker, Jr., Sales Representative, Allis-Chalmers Manufacturing Company, Detroit, Mich.

At the beginning of the discussion it was emphasized that the answer to this question is the individual himself.

It is realized that there are many factors which influence one's success. The panelists concentrated on three of these important factors, namely:

1 Job Performance
2 Outside Activities
3 Self Evaluation

The high lights of the discussion were:

1 Job Performance.
- (*a*) Seriousness and the true sense of responsibility on the job.
- (*b*) Analyze your job carefully. Do you belong in administration or in strictly technical work.
- (*c*) Know the consumer—know your company.

2 Outside Activities.
- (*a*) Professional Society participation.
  - 1 Opportunity to benefit from technical papers and journals.
  - 2 Maintain technical integrity.
  - 3 Stimulation of new ideas.
- (*b*) Professional Registration.
  - 1 Write examinations as soon as possible following graduation.
  - 2 Professional prestige.
  - 3 Professional registration is becoming equally important in all phases of engineering work.
- (*c*) Advanced Education.
- (*d*) Civic Activities.
  - 1 Political.
  - 2 Educational.
  - 3 Social.
  - 4 Religious.

3 Self Evaluation.
- (*a*) Be as objective as possible.
- (*b*) Make periodic analysis.
  - 1 Technical capabilities.
  - 2 Vocational aptitude.
- (*c*) Indications of present effectiveness.

The complete discussion may be obtained in printed form by ordering ASME Paper No. 58—SA-51. (Will be available until April, 1959.)

The Chairman of the session was George M. Kurajian, Assoc. Mem. ASME, Assistant professor of Engineering Mechanics, University of Detroit, Detroit, Mich.

The Vice-Chairman was Edward F. Hoelscher, Jr., Assoc. Mem. ASME, project engineer, American Blower Division of American Radiator and Standard Sanitary Corporation, Detroit, Mich.

National ASME officers, National Junior Committee Officers, members of the Old Guard, and junior guests of the Old Guard were present.

A discussion followed with a number of the audience participating.

[1] Product Planning Engineer, Western Electric Company, North Andover, Mass. Assoc. Mem. ASME.

[2] Project Engineer, American Blower Division of American Radiator and Standard Sanitary Corporation, Detroit, Mich. Assoc. Mem. ASME.

Chairman's Corner

REGION V is establishing a Regional Young Associate Committee. The Region V-Young Associate Committee, composed of members representing each of the 14 Sections of the Region, will attempt to make known the activities and policies of the National Junior Committee and, in turn, report on the Regional and Sectional activities.

Organizations such as this (also existing in Region VI and VII) will aid the National Junior Committee in fulfilling its objectives of developing, implementing, and practicing of policies and procedures directed toward the professional development of young engineers and the encouragement of Associate Members to participate in the affairs of ASME.

W. V. Chambers,
Chairman, National Junior Committee
General Electric Company
Cincinnati 15, Ohio

UET *(Continued from page 131)*

sixth conference, held at the University of Florida, December, 1957, attracted a wide attendance from foreign countries. Invitations to hold the seventh conference abroad have already been received from Portugal, England, and Holland.

Documentation in Engineering

This year Engineering Foundation is making an initial grant to a program concerned with Documentation in Engineering—a joint project of four major engineering societies, the American Society for Metals, and Western Reserve University. The Council on Documentation Research was established at Western Reserve two years ago to promote wider use and better understanding of recorded scientific and technical information. Its long-range goal is to stimulate research and development in the field, to encourage the co-operation of those actively concerned with documentation, and especially to make the enormous volume of engineering research being published today more readily available to practicing engineers.

Formed in 1914, Engineering Foundation was a pioneer in recognizing the importance of research. Its current endowment fund is about $2 million. Though the income from this fund is modest in comparison with present-day research outlays, the Foundation has through the years initiated and kept alive many important research programs that were later able to obtain large-scale financial backing from industry.

COMING MEETINGS

Heat Transfer

NORTHWESTERN University will be host to the second national Heat Transfer Conference with meetings scheduled at the University's Technological Institute August 18–20. More than 500 scientists, researchers, and equipment manufacturers will attend. Thirty papers concerning both theoretical and practical aspects of heat transfer will be presented.

Systems Engineering and Operations Research

The Pennsylvania State University will conduct its first Seminar on Systems Engineering and Missiles Operations Research at University Park, Pa., August 18–23. The one-week seminar is planned for the presentation of the status of operations research and systems engineering in which the underlying principles are described and their application demonstrated by considering a typical guided-missile systems analysis.

Further information may be obtained from the Extension Conference Center, The Pennsylvania State University, University Park, Pa.

Naval Hydrodynamics

The Second Symposium on Naval Hydrodynamics, sponsored by the Office of Naval Research and the National Academy of Sciences-National Research Council, will be held in Washington, D. C., from August 25–29. The intent of this symposium is to focus detailed attention on aero and hydrodynamic noise and supercavitating and ventilated flows.

The program for the symposium includes papers on: theory and experiments in aerodynamic research, developments in turbulence theory, boundary-layer noise and pressure-fluctation measurement, flow excited resonators, fully developed cavity flow in pumps, the design and performance of supercavitating propellers, and many more.

Meetings will be open to all those interested. The program will include tours of Navy Laboratories in the Washington area. Further information may be obtained by writing Phillip Eisenberg, Mechanics Branch, Office of Naval Research, Washington 25, D. C., or G. W. Wood, National Academy of Sciences-National Research Council, Washington 25, D. C.

IMECH E MEETINGS

Sept. 23–25

International Conference on Gearing, IMechE, London, England.

Oct. 28

Symposium on Aluminum Pressure Vessels, IMechE, London, England.

▶ *Note:* The foregoing calendar of The Institution of Mechanical Engineers (Great Britain) meetings is published as a service to members of ASME. Further information relating to complete programs and available papers may be obtained from The Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London, S. W. 1, England. Preliminary programs also are published in *The Chartered Mechanical Engineer* (IMechE) which is on file in the Engineering Societies Library, 29 West 39th Street, New York 18, N. Y., and other libraries throughout the United States and Canada.

ASME CODES AND STANDARDS WORKSHOP

Letter Symbols for Hydraulics Revision Approved

By J. M. Robertson

Chairman, Y10 Subcommittee 2

HYDRAULICS is a broad and somewhat divergent field. Preparation of the present relatively short list of symbols was based on a list of more than 400 obtained from various hydraulic and related sources. This standard is submitted as a suggestion to authors of works on hydraulics in the hopes that it will lead to greater uniformity. It hardly is regarded as an ironclad promulgation, since in a few instances all members of the subcommittee were not in agreement. Care has been taken to obtain as much conformity as possible with symbols used in closely allied fields.

New Standard on Letter Symbols for Petroleum Reservoir Engineering and Electric Logging Approved

By Francis Collins

Chairman, Petroleum Branch, AIME, Symbols Committee

A PROPOSED standard on Letter Symbols for Petroleum Reservoir Engineering and Electric Logging has received the approval of the American Standards Association. The proposal received a favorable vote by the members of ASA Sectional Committee Y10 on Letter Symbols, and was submitted to the ASA for approval by The American Society of Mechanical Engineers as sole sponsor of the sectional committee.

These symbol lists were prepared by a committee of the Society of Petroleum

Engineers of the American Institute of Mining, Metallurgical and Petroleum Engineers and were made compatible with existing symbol standards in overlapping fields.

Slotted and Recessed Head Tapping Screws and Metallic Drive Screws Approved

By L. A. Oest

Chairman, B18 Subcommittee 3, Subgroup 1

THE steady growth of popularity and demand for Tapping Screws and Type "U" Metallic Drive Screws, which are used as high-production commercial fasteners, stimulated requests and suggestions from users and producers, calling for this revised publication. Many useful data have been added to ASA B18.6.4 since the 1947 publication, which concerned Thread Forming Screws only. This new standard includes Thread Forming Screws, the various types of Thread Cutting Screws, and Type "U" Metallic Drive Screws. Without doubt, all of the added material is valuable to every user and producer of Tapping Screws. We have herein attempted to summarize in general terms the new information which is made available in this expanded publication.

The Thread Forming Screws, Types A, B, BP, and C; the Thread Cutting Screws, Types F, G, and T; and the Type "U" Metallic Drive Screws are described in the Introductory Notes, as well as the Thread Forming Tapping Screws, Types A, B, and C, which appeared in the 1947 edition.

Some of the new features contained in this standard are the relative functionability of all types of Tapping Screws, the general specifications of Thread Forming and Thread Cutting Tapping Screws, and the functional data applying to the Type "U" Drive Screw for permanent fastenings. In addition, other helpful information, such as the new standards controlling lengths of threaded and unthreaded shank and a clear specification of materials and material hardness for use in the performance test of the tapping screws, is included in the Introductory Notes.

In Appendix I, inspection and quality-control techniques are outlined for the benefit of users and producers. Also included are construction and use of "Protrusion Gages," formulas based on manufacturing and functional limitations used to determine flushness, and the principal dimensions of the screws to be tested by the use of the gage.

The construction and use of "Penetration Gages" is described in Appendix II. Formerly, depth of recess was the only criterion for recess inspection. Now penetration gaging, used in conjunction with depth gaging, provides a definite recess standard and a positive check for product quality.

In addition to the dimensional tables for the various styles of standard heads, Appendix III provides formulas to calculate the various types of standard and special heads that may be needed by the users and producers of Tapping Screws for design purposes.

The hole-size data shown in Appendix IV for all types of Tapping Screws and for the Type "U" Metallic Drive Screws are recommendations covering a variety of materials over a wide range of material thickness and are both useful and important to the users.

Of ultimate importance for quality control is a functional test. The "Drive Test" and "Referee Test" are outlined in Appendix IV. The Drive Test provides a definite check of functionability, while the Referee Test provides for an indication of the homogeneity and strength of the fasteners, over and above the functional requirements.

A conversion chart called "Type Designation of Tapping and Type 'U' Metallic Drive Screw" is included in this standard to identify the ASA, manufacturers', and Federal Service's designations.

The foregoing is a condensed version of some of the highlights of this document, which the American Standards Association approved as an American Standard on June 4, 1958. Copies are obtainable from the ASME Order Department, 29 West 39th Street, New York 18, N. Y., at $4 each.

Renewal of The ASME Certificates of Authorization for Code Construction

THE current Certificates of Authorization, permitting holders to use the Society's Code Symbol Stamps in construction covered by The ASME Boiler and Pressure Vessel Code, will expire Dec. 31, 1958. These Certificates are issued for a period of three years and applications for their renewal for the period ending Dec. 31, 1961 were mailed from Society Headquarters during June and July to current holders. In addition to the application forms, information was attached giving references to data sources for Code users. It is suggested that Certificate holders complete and return the applications as soon as practical to permit early issue of the renewals.

ASME Boiler and Pressure Vessel Code Nuclear Case Interpretations

A BOOKLET containing all adopted Nuclear Case Interpretations based on industry requests is now available from the ASME Order Department.

The rules of the Power Boiler Section and the Unfired Pressure Vessel Section of the ASME Code are considered by the ASME Boiler and Pressure Vessel Committee as basically appropriate for the construction of pressure-vessel equipment in nuclear power plants. Where special conditions are encountered in nuclear applications for which there are no provisions in the present Code, the Committee prepares Case Interpretations applicable to those sections of the Code.

This booklet contains all Nuclear Cases in effect on April 25, 1958. Periodically it will be revised to include any additions and revisions. Price is $1.25.

New Power Test Code for Safety and Relief Valves

By R. C. Binder

Chairman of PTC Committee No. 25

MANUFACTURERS and users of safety and relief valves should welcome the new Power Test Code for Safety and Relief Valves that has just been issued by The American Society of Mechanical Engineers. Over the years the Society has received numerous suggestions that such a test code be prepared. This new code provides a recommended test procedure and instrumentation for testing safety and relief valves. Attention is given to the determination of relieving pressure, relieving capacity, coefficient of discharge, opening pressure, and other valve characteristics. Establishment of valve ratings and rules of safe construction fall within the province of groups other than the technical committee which prepared this test code.

Parts of the code deal with certain test features common to any fluid. In the section on Instrumentation are three separate divisions: one on testing with steam, one on testing with gas or air, and one on testing with liquids. This code is applicable only to tests in which the discharge is at atmospheric pressure.

In December, 1948, the ASME Boiler and Pressure Vessel Committee recommended to the ASME Power Test Codes Committee that a test code be prepared on the testing of safety and relief valves. In October, 1949, the Power Test Code

ASME COMING EVENTS

(For Meetings of Other Societies, see page 125)

August 18–21

ASME-AIChE Heat Transfer Conference, Edgewater Beach Hotel, Chicago, Ill.

September 8–9

ASME Applied Mechanics Western Conference, University of California, Los Angeles, Calif.

September 15–17

ASME Process Industries Conference, Statler-Hilton Hotel, Buffalo, N. Y.

September 21–24

ASME Petroleum Mechanical Engineering Conference, Cosmopolitan Hotel, Denver, Colo.

September 28–October 1

ASME Power Conference, Statler-Hilton Hotel, Boston, Mass.

October 9–10

ASME-AIME Fuels Conference, Hotel Champlain, Old Point Comfort, Va.

October 13–15

ASME-ASLE Lubrication Conference, Statler-Hilton Hotel, Los Angeles, Calif.

November 30–December 5

ASME Annual Meeting, Statler-Hilton and Sheraton-McAlpin Hotels, New York, N. Y.

March 8–11, 1959

ASME Gas Turbine Power Conference and Exhibit, Netherlands-Hilton Hotel, Cincinnati, Ohio

March 8–12, 1959

ASME Aviation Conference, Statler-Hilton Hotel, Los Angeles, Calif.

April 5–10, 1959

Nuclear Congress, Cleveland Auditorium, Cleveland, Ohio

April 13–15, 1959

ASME Hydraulics Conference, University of Michigan, Ann Arbor, Mich.

April 19–23, 1959

ASME Oil and Gas Power Conference, Shamrock-Hilton Hotel, Houston, Texas

April 23–24, 1959

ASME Management-SAM Conference, Statler-Hilton Hotel, New York, N. Y.

April 29–May 3, 1959

ASME Metals Engineering Conference, Sheraton-Ten Eyck Hotel, Albany, N. Y.

May 4–5, 1959

ASME Maintenance and Plant Engineering Conference, Edgewater Beach Hotel, Chicago, Ill.

May 12–14, 1959

ASME Production Engineering Conference, Statler-Hilton Hotel, Detroit, Mich.

May 25–28, 1959

ASME Design Engineering Conference, Convention Hall, Philadelphia, Pa.

June 14–18, 1959

ASME Semi-Annual Meeting, Chase-Park Plaza Hotel, St. Louis, Mo.

June 18–20, 1959

ASME Applied Mechanics Conference, Virginia Polytechnic Institute, Blacksburg, Va.

Note: Members wishing to prepare a paper for presentation at ASME national meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for which there is no charge providing you state that you are a member of ASME.

Committee No. 25 on Safety and Relief Valves was appointed. When the test code was completed by the technical committee, it was approved by the standing Power Test Codes Committee. It was then approved and adopted by the Council as a standard practice of the Society by action of the Board on Codes and Standards on March 27, 1958.

The members of PTC Committee No. 25 are: R. C. Binder, chairman, Purdue University; W. W. Starke, secretary, The J. C. White Engineering Corporation; L. J. Brown, E. I. du Pont de Nemours & Company, Inc.; Solomon Chesler, The M. W. Kellogg Company; M. W. Garland, Frick Company; W. P. Kliment, Crane Company; E. O. Mattocks, American Petroleum Institute; E. H. Mitsch, The Cincinnati Gas & Electric Company; F. M. RePass, Manning, Maxwell & Moore, Inc.; E. B. Ripley, The Connecticut Light & Power Company; J. A. Shannon, Fidelity and Casualty Company of New York; J. C. Souder, Esso Research and Engineering Company; B. H. Stolpestad, Crosby Steam Gage & Valve Company; and N. E. Ziege, Manning, Maxwell & Moore, Inc.

Pamphlet copies of the test code are available from the Society's Order Department for $2.50 a copy.

ASME 1959 Nominating Committee Organizes

ELECTED at the 1958 Semi-Annual Meeting of The American Society of Mechanical Engineers, Detroit, Mich., June 17, 1958, the 1959 National Nominating Committee at its organization meeting chose Allen H. Jensen as chairman and William G. McLean as secretary.

The 1959 National Nominating Committee is composed of the following:

Region I. *Representative*, John P. Heumann, mechanical engineer, research department, Olin Mathieson Chemical Corp., 275 Winchester Ave., New Haven 4, Conn.; *1st Alternate*, Rodger B. Dowdell, fluid mechanical engineer, Builders-Providence Inc., Div. B-I-F Industries, 345 Harris Ave., Providence, R.I.; *2nd Alternate*, Charles G. Parker, Negea Service Corp., 727 Massachusetts Ave., Cambridge 39, Mass.

Region II. *Representative*, U. A. Rothermel, assistant professor, mechanical-engineering department, City College of New York, Convent Ave. at 139th St., New York 31, N.Y.; *1st Alternate*, Walter B. Moen, assistant director of metallurgical research, Air Reduction Co., Inc., Murray Hill, N. J.; *2nd Alternate*, James R. Muenger, Beacon Research Laboratories, The Texas Co., Beacon, N. Y.

Region III. *Representative*, William G.

Process Industries Division Conference, September 15–17

THE Process Industries Division of The American Society of Mechanical Engineers will hold a national conference at the Hotel Statler in Buffalo on Sept. 15–17, 1958. Two panel discusssions on "Process Mixing" and "Value of Pilot Plants Maintained by Equipment Manufacturers" are scheduled. Several plant trips have been planned in addition to the regularly scheduled technical sessions. Among the honored guests at the banquet on September 16 will be Ronald B. Smith, Director, representing James N. Landis, ASME President. Dr. Clifford Furnas, Mem. ASME, President of the University of Buffalo, is to be the banquet speaker.

McLean, head, department of mechanics, Lafayette College, Easton, Pa.; *1st Alternate*, William E. Hammond, chief engineer, The Air Preheater Corp., Andover Road, Wellsville, N. Y.; *2nd Alternate*, Wallace E. Belcher, Jr., group leader, Brown Instruments Div., Minneapolis-Honeywell Regulator Co., Wayne & Windrim Aves., Philadelphia 44, Pa.

Region IV. *Representative*, Harold K. Couch, partner, Brown & Morrison, 207 Liberty Life Building, Charlotte 2, N. C.; *1st Alternate*, John C. Reed, head professor of mechanical-engineering department, University of Florida, Gainesville, Fla.; *2nd Alternate*, Carl S. Dennis, fuel service engineer, Coal Traffic Engineering Division, Chesapeake & Ohio Railroad Co., 601 First National Bank Building, Richmond 10, Va.

Region V. *Representative*, Winthrop I. Collins, district sales manager, The Babcock & Wilcox Co., 2730 Koppers Building, Pittsburgh, Pa.; *1st Alternate*, William C. Beatty, administrative project engineer, Canton Div., E. W. Bliss Co., 1375 Raff Road, S.W., Canton 10, Ohio; *2nd Alternate*, John D. Carr, superintendent, charge of rolling and conditioning, Heavy Rolling Mills Div., U.S. Steel Corp., 912 Salt Spring Road, Youngstown, Ohio.

Region VI. *Representative*, Robert D. Teece, manager, Central Engineering Div., Harnischfeger Corp., 4400 W. National Ave., Milwaukee 15, Wis.; *1st Alternate*, T. Randall DuBois, retired, 6208 Rosebury Drive, St. Louis 5, Mo.; *2nd Alternate*, Edward W. Jerger, associate professor, mechanical-engineering department, University of Notre Dame, Notre Dame, Ind.

Region VII. *Representative*, Richard H. Meleney, Convair-Astronautics, Div. of General Dynamics Corp., San Diego 12, Calif.; *1st Alternate*, Emmett E. Day, professor of mechanical engineering, mechanical-engineering department, University of Washington, Seattle 5, Wash.; *2nd Alternate*, Frank J. Fontana, chief engineer, Watson Refinery Div., Richfield Oil Corp., Box 787, Wilmington, Calif.

Region VIII. *Representative*, Allen H. Jensen, engineer, New Orleans Public Service, Inc., Market St., New Orleans, La.; *1st Alternate*, John W. McKiernan, division supervisor, Sandia Corp., Sandia Base, Albuquerque, N. Mex.; *2nd Alternate*, Robert G. Critz, product-design engineer, Bethlehem Supply Co., Box 2171, Tulsa 2, Okla.

Technical Division. *Representative*, Allen W. Thorson, manager, reactor operations, General Electric Co., West Milton Site, West Milton, N. Y.; *1st Alternate*, Everett P. Partridge, director, Hall Laboratories, Inc., Div. of Hagan Chemical & Controls, Inc., P.O. Box 1346, Pittsburgh 30, Pa.; *2nd Alternate*, Kerr Atkinson, consulting engineer, Statler Office Building, Boston 16, Mass.

Codes and Standards. *Representative*, Rawleigh Mac Johnson, engineer, Charge of Tests, Compressor Div., Ingersoll-Rand Co., Phillipsburg, N. J.; *1st Alternate*, Henry E. Aldrich, manager, American Boiler & Affiliated Industries, 15 Park Row, Room 2502, New York 38, N. Y.; *2nd Alternate*, Zenas R. Bliss, Provost, professor of engineering, Engineering & Administration Div., Brown University, Providence 12, R. I.

Administrative. *Representative*, Harold E. Martin, president, Metal & Thermit Corporation, 100 Park Ave., New York 17, N. Y.; *1st Alternate*, George B. Thom, chairman, mechanical-engineering department, Newark College of Engineering, 367 High St., Newark 2, N. J.; *2nd Alternate*, Clair B. Peck, retired, 16C Troy Drive, Springfield, N. J.

Memorial to ASME Member to Aid Crippled Children

The late Colonel Elbridge W. Palmer, Associate ASME, who died in 1953, had for many years been active in the interests of handicapped and crippled children. In addition to being the head of a large book-manufacturing company, he had served for nine years as president of the National Society for Crippled Children.

In his memory, his home town of Kingsport, Tenn., has recently dedicated the Palmer Memorial Center. The Center will serve handicapped children in the East Tennessee-Southwest Virginia region. Its program includes grade-school training, speech treatment, and physical and occupational therapy. Regular pediatric, orthopedic, and neurological clinics are also held for victims of cerebral palsy and other conditions.

Establishment of the $165,000 Center was made possible entirely by the voluntary contributions of residents and organizations in Kingsport and the vicinity.

ACTIONS ASME EXECUTIVE COMMITTEE

At Semi-Annual Meeting, June 14, 16, and 17, 1958, Held at the Statler-Hilton Hotel, Detroit, Mich.

The Council of The American Society of Mechanical Engineers met in five sessions during the Semi-Annual Meeting, Statler-Hilton Hotel, Detroit, Mich., June 14, 16, and 17, 1958. There were present: J. N. Landis, President; E. W. Allardt, H. S. Aurand, W. H. Byrne, C. E. Crede, J. H. Sams, C. H. Shumaker, R. S. Stover, and A. W. Weber, vice-presidents; E. O. Bergman, E. W. Jacobson, Louis Polk, L. N. Rowley, R. B. Smith, V. W. Smith, and G. B. Warren, directors; A. D. Bailey, E. G. Bailey, J. W. Barker, D. W. R. Morgan, and W. F. Ryan, past-presidents; O. B. Schier, II, secretary.

Also present: R. L. Goetzenberger, F. W. Miller, and S. D. Moxley, former members of Council; C. B. Campbell, Constitution and By-Laws; H. D. Harkins, Board on Honors; W. C. Foster, Board on Public Affairs; A. B. Heiberg, C. A. Davis, H. K. Couch, J. P. Heumann, R. B. Kinzbach, L. C. Koke, R. H. Meleney, A. W. Thorson, Nominating Committee; W. E. Belcher, Jr., A. H. Jensen, Agenda Committee; A. T. Kniffen, secretary, Region II, Harold Grasse, secretary, Region VIII, F. H. Bayha, Fort Wayne Section, S. R. Beitler, G. M. Muschamp, J. W. Little, R. J. Hazelrigg, W. J. Larkin C. G. Southmayd, representative on EIC Council, A. G. Christie, ASME-EIC International Council, guests; H. A. Jespersen, J. D. Carr, Rhein Benninghoven, L. D. Conta, H. O. Fuchs, Eugene Linsker, D. E. Marlowe, H. J. McCabe, W. C. Millis, C. F. Nichols, F. R. O'Brien, A. M. Perrin, E. W. Randall, J. E. Rudolph, and H. S. Weber, Regional Delegates; T. A. Marshall, Jr., senior assistant secretary; W. E. Reaser, S. A. Tucker, J. D. Wilding, assistant secretaries; J. J. Jaklitsch, Jr., Editor; Ernest Hartford, consultant; D. B. MacDougall, Meetings and Divisions manager; and A. B. Conlin, Jr., assistant Meetings and Divisions manager.

The following actions are of general interest:

Announcements. A letter of appreciation from Mrs. Edith A. Swain for the expression of sympathy from the Council on the death of her husband, Philip W. Swain, was read by the Secretary.

The death of Mrs. Frederick S. Blackall, jr., on June 5, 1958, was reported. The following Honorary Vice-Presidents attended Mrs. Blackall's funeral on June 9: W. F. Ryan, C. E. Crede, Clarke Freeman, and R. B. Dowdell. The Secretary also attended.

It was reported that Henry Marx would be 100 years old on June 22, 1958, and the Secretary was asked to convey the best wishes of the Council to him.

The President reported that Miami University had conferred an honorary DS degree on Director Louis Polk.

S. C. Mitri, staff assistant to the Meetings and Divisions Department, was introduced.

ASME Budget, 1958–1959. Policies and budgets for 1958–1959 were approved.

Constitution and By-Laws Committee. The Council voted to adopt amendments to Art. B6A, Pars. 7, 12, 18, 18-A, 18-B, and 20; Art. B7, Pars. 1(*d*) and 19; and Art. 7, Rule 1, all of which were offered for first reading Nov. 30.

The Council also voted to adopt the amendments to Art. R10, Rules 1, 3, 4, 9, and 11, to become effective when By-Laws B6A, Pars. 14, 14-c, and 14-c-1 are adopted.

Board on Honors. On recommendation of the Board on Honors the following awards for 1958 were approved:

ASME George Westinghouse Medal to Frederick P. Fairchild, Fellow ASME.

Spirit of St. Louis Medal to George S. Schairer.

Timoshenko Medal to Arpad L. Nadai, Fellow ASME; Geoffrey I. Taylor and Theodore von Karman, Mem. ASME.

Worcester Reed Warner Medal to Harold J. Rose, Mem. ASME.

Melville Medal to Thomas P. Goodman, Assoc. Mem. ASME, for his paper, "An Indirect Method for Determining Accelerations in Complex Mechanisms."

Prime Movers Committee Award to Vivian F. Estcourt, Fellow ASME, for his paper, "Plant Management and Other Factors Affecting Maintenance Costs in Steam Generating Stations."

Blackall Machine Tool and Gage Award to S. A. Tobias and W. Fishwick for their paper, "The Chatter of Lathe Tools Under Orthogonal Cutting Conditions."

Spirit of St. Louis Junior Award to Melvin L. Baron, Assoc. Mem. ASME, for his paper, "Response of Nonlinearly Supported Spherical Boundaries to Shock Waves."

Richards Memorial Award to Donald C. Burnham, Mem. ASME.

Pi Tau Sigma Gold Medal Award to Allison K. Simons, Assoc. Mem. ASME.

Decentralization of Honors Presentation. The Council voted to endorse in principle the decentralization of Honors Presentation as proposed by the Meetings Committee.

Spirit of St. Louis Medal and Spirit of St. Louis Junior Awards. Upon recommendation of the Medals Committee, the Council voted to present both these medals during the 1959 Semi-Annual Meeting to be held in St. Louis.

Charles T. Main Topic. Upon recommendation of the Board on Honors, the Council voted to accept "Professional Attitudes of the Engineer" as the topic for the 1959 Charles T. Main Award.

Research Extension Agreement with Battelle Memorial Institute. The Council voted to authorize the Secretary to sign the extension agreement with Battelle Memorial Institute for the continuation of the work on the collection and preparation of high-temperature data for punch-card distribution at a cost not to exceed $1000.

Committee of Mechanical-Engineering Department Heads. Upon recommendation of the Vice-Presidents, the Council voted to recommend to the Organization Committee the establishment of a Committee of Heads of Mechanical-Engineering Departments under the Board on Education.

Sections. On recommendations of E. W. Allardt, Vice-President, Region V, assignment of certain counties in Ohio and West Virginia to the West Virginia Section and Canton-Alliance-Massillon Section was authorized; the establishment of the Central Michigan Section was authorized subject to a check of the required number of paid-up members.

On recommendation of C. H. Shumaker, Vice-President, Region VIII, the establishment of the Central Arkansas Subsection of the Mid-Continent Section, with headquarters at Little Rock, Ark., was authorized.

With requirements of the Executive Committee of the Council fulfilled, the Hamilton-Niagara Subsection of the Ontario Section was authorized. It was reported that the required 50 paid-up members have signed the petition, Hamilton to be headquarters city, and the ASME-EIC International Council approved the formation of the Subsection at its meeting in Quebec City, May 23, 1958.

On recommendations of A. W. Weber, Vice-President, Region III, the Council authorized Section status for the Mohawk Valley Subsection of the Syracuse Section, with headquarters at Utica; the Schenectady Section was authorized to change its name to the Hudson-Mohawk Section.

On recommendation of J. H. Sams, Vice-President, Region IV, the establishment of the North Alabama-Mississippi Section, with headquarters at Huntsville, Ala., was authorized.

On recommendation of H. S. Aurand, Vice-President, Region VII, the Southern California Section was authorized to change its name to Los Angeles Section.

Annual Meeting, Nov. 29–Dec. 5, 1958. The schedule of meetings for the Council was accepted. "Your Part in the Unity of the Profession," the topic for the Sunday Evening meeting was approved. The Meetings Committee recommendation to schedule the Annual Banquet on Thursday, Dec. 4, 1958, was approved.

Roy V. Wright Lecture. Joseph W. Barker has been chosen to deliver the lecture at the 1958 Annual Meeting, Wednesday, December 3, at a special luncheon, at 12:15 p.m.

Towne Lecture. Walter Boveri has been invited to deliver the Towne Lecture at the Management Luncheon during the 1958 Annual Meeting on Tuesday, December 2, at 12:15 p.m.

Annual Report. The preparation and distribution of the 1958 Annual Report to all members as a supplementary edition to the January, 1959, issue of MECHANICAL ENGINEERING was authorized.

Sweetser Bequest. The Council voted to accept $20,198.32 as the sum of the Elizabeth M. Sweetser bequest, which is to constitute a fund to be known as the "William Jordan Sweetser Fund" and to be added to and become a part of the Students Loan Fund of ASME.

Certificates of Award. Certificates of Award were granted to the following retiring chairmen of Sections: Central Indiana Section, Robert A. Olsen; Inland Empire Section, Milton E. Davey; Iowa-Illinois Section, Harvey L. Windmiller; Metropolitan Section, Arthur M. Perrin; North Texas Section, Irving Comroe; Northwest Florida Section, E. E. Burroughs; St. Louis Section, John K. Bryan; Schenectady Section, Robert Plunkett; and Southern Tier Section, Arthur H. Burr.

Certificates also were granted to the following retiring members of the 1958 Nominating Committee: Arthur B. Heiberg, chairman; Charles A. Davis, secretary; Roger M. Scott, James L. O'Neill, George R. Leavitt, Kenneth R. Daniel, Leonard C. Koke, Robert B. Kinzbach, Jess H. Davis, A. William Meyer, and Robert Nelsen.

Engineering Institute of Canada. E. G. Bailey, chairman, Committee to Review the EIC Relationship, presented the report which was approved by the Council. The committee's work having been completed, the Council discharged the Committee with thanks for its efforts.

EIC Representative to ASME. The Engineering Institute of Canada has been invited to designate a representative to attend meetings of the ASME Council without vote.

New Engineering Center. The Secretary summarized the procedures followed in conducting the Member-Giving Campaign within the Society for the New United Engineering Center. All Sections have received their instructions and all Regions are well advanced in the organization of Committees to solicit funds for the new building. Staff was instructed to send the Vice-Presidents the UET list of companies now being called on by Dr. Kelly's Committee.

Regional Delegates Conference. H. A. Jespersen, Speaker of the 1958 Regional Delegates Conference, presented the recommendations of the Conference to the Council, which expressed appreciation of the work of the Delegates and referred the recommendations to the committees concerned for report to the Council.

Appointments. The following presidential appointments were reported:

Inauguration of Dr. Glenn S. Dumke as President, San Francisco State College, May 2, 1958, Arthur V. Ingraham.

Third U. S. National Congress of Theoretical and Applied Mechanics, Brown University, June 11–14, William F. Ryan.

To act as alternate for H. V. Coes who was hospitalized and unable to attend the May 27, 1958, meeting of the ASME Board on Honors, W. A. Shoudy.

Resignation as Member of Council. Charles E. Crede, Vice-President, Region I, has accepted an appointment on the faculty of California Institute of Technology, in Pasadena, Calif., which makes it necessary for him to resign his office, term of which would have expired Dec. 1, 1959. Prof. Charles H. Coogan, Jr., has been nominated to replace Mr. Crede, it was later reported.

Marston Award. Arthur Q. Adamson is the recipient of the 1958 Marston Award. The award is conferred on an engineering alumnus of Iowa State College of at least 30 years' standing.

W. F. Durand. Dr. Durand, past-president and Hon. Mem. ASME, a member of the Society since 1883, is now 99 years of age and has been incapacitated for the past year. The Society has provided him with flowers, fruits, candy, and drives in the open air when his physician permitted. Hospitalization has been recommended.

Disability Insurance Plan. The Secretary reported that the Disability Insurance Plan for ASME members became effective on June 1, 1958, when more than 100 applications were received by the Administrator. Acceptances have far exceeded the anticipated number. Letters from the membership have been generally favorable.

Resolution of Thanks. The Council extended their thanks and sincere appreciation to the officers and members of the Detroit Section for their "Generous hospitality, gracious courtesies, and pleasant weather."

EXECUTIVE SESSION OF THE COUNCIL

The Council met in executive session on the evening of June 14, 1958.

Honors. Upon recommendation of the Board on Honors, the Council unanimously voted to elect as Honorary Members of the Society the following: John Blizard, Howard Coonley, James E. Gleason, and Ernest L. Robinson; and awarded the 1958 ASME Medal to Wilbur H. Armacost.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

THE application of each of the candidates listed below is to be voted on after Aug. 25, 1958, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and •Transfers

Arkansas

•BALL, NORMAN D., Malvern

California

ACKERSON, ROBERT D., La Mesa
•ERICKSON, CARL G., San Diego
HICKEY, WILLIAM G., Van Nuys
ISAACS, CHARLES R., Los Angeles
PORTER, LAWRENCE C., South Gate
ROBERTS, WILLIAM E., Culver City
•RODRIGUEZ, CHARLES J., Canoga Park
•SAMPSON, RICHARD D., Placerville
•SCHROCK, VIRGIL E., Berkeley
SMITH, JAMES W., Millbrae
•STOFFEL, EDWARD O., San Luis Obispo
THOMAS, LACY G., Palo Alto
•VAN DEERLIN, DAVID B., La Canada
ZINS, PAUL J., Los Angeles

• Transfer to Member or Affiliate.

Colorado

•SMITH, RAYMOND V., Fort Collins

Connecticut

•HAYES, LOUIS T., Noroton
•ODEGAARD, EUGENE A., Wethersfield

District of Columbia

PAN, CHING-LOH, Washington

Georgia

NONWEILER, KARL H., Atlanta
RAGAN, CHARLES E., Atlanta

Hawaii

HEE, JOSEPH, Honolulu

Idaho

•OSTERGAARD, PALLE C., Idaho Falls

Illinois

BAUR, JOHN W., Chicago
•BLOESCH, HERMAN G., Chicago
BOWMAN, DWIGHT G., LaGrange
DENAVIT, JACQUES, Evanston
KILGUS, FREDERICK, Chicago
MCGRAW, GEORGE P., JR., Chicago
PETTERSEN, GEORGE A., Western Springs
SCHWARTZ, FREDERICK W., JR., Chicago
SHEIKH, ATTA I., Chanute Air Force Base
VERGIN, LEO F., Chicago

Indiana

•ANDERSON, CHARLES L., JR., Fort Wayne
•DANIEL, RUSSELL D., Bloomington

Kentucky

•LA CROSSE, EMMART, JR., Louisville

Louisiana

CRAIG, CHARLES E., JR., Baton Rouge
•RANNA, JOSEPH J., New Orleans
•RICHARDS, VINCENT L., Baton Rouge
WHITE, GILBERT T., New Orleans

Maryland

BROWN, ROLAND L., JR., Baltimore
•BURGAN, HAROLD C., Baltimore
•DOUGLASS, ROBERT M., Baltimore
FRANK, MARVIN, Silver Spring
•PATRICK, MERILL F., Baltimore
WATERS, MURRAY G., Baltimore

Massachusetts

•ALBERTO, FRANCIS J., Foxboro
ASTLEY, BENJAMIN P., Holyoke
•BALDWIN, H. BROWN, Medfield
GILMAN, EDWARD A., Hull
NOVAK, CURTIS W., Worcester
PSAROUTHAKIS, JOHN, Cambridge
RAMRATH, FRANK A., South Weymouth
SIBLEY, ALDEN K., Boston
•STASZESKY, FRANCIS M., Boston
•ZALIS, ALBERT A., Warren
•ZAWORSKI, ROBERT J., Sharon

Michigan

•Beck, Jerry G., Oak Park
•Chow, Weichien, Jackson
Geisinger, Joseph M., Detroit
Janus, Peter B., Detroit
Rohrig, Ignatius A., Detroit
Severance, Arnold W., Jackson
Webster, Gordon L., Flint

Missouri

Bayne, William E., Independence
•Novick, Walter C., Kansas City

New Jersey

Bartholet, Emil J., Cranford
•Bianculli, Anthony J., Bloomfield
•Bush, Austin R., Madison
•Geiger, Hugh C., Woodbury
Halter, Rene O., West Caldwell
•Herman, Sherman A., Colonia
Magnusson, John S., Montclair
McKeown, John C., Camden
•Murphy, Carroll T. G., Englewood
Warner, Ronald E., Glassboro

New York

•Avallone, Eugene A., New York
Baker, Clyde A., Corning
Campbell, Henry J., Jr., Mineola
•Dunn, Thomas J., New York
Ellis, Gaylord O., Syracuse
Finale, Philip, New York
Forrest, Lester, Westbury
Fortune, Philip R., Watertown
Hahn, John R., Rochester
Henkel, Stephen C., New York
Kobler, Robert J., Sidney
Marras, Steven W., New York
Mayo, Hays C., Bayside
O'Regan, Patrick M., Olean
Owens, Joseph A., Jonesville
•Sherman, Paul E., Schenectady
•Soderberg, C. Richard, Jr., New York
Weil, Nicholas A., New York
Welden, Robert P., New York
•Wunsch, Eric M., New York
•Zak, Edward J., Corning

North Carolina

•Elsevier, Ernest, Durham
Fuchs, Francis J., Jr., Winston-Salem
•Kemp, Robert B., Fort Bragg

North Dakota

Hoefs, Kenneth W., Hankinson

Ohio

•Born, Robert F., Columbus
Dreibelbis, Logan L., Cincinnati
Elovic, Ernest, Cincinnati
•Gulaian, Vartan A., East Cleveland
•Haspelmath, Charles E., Cincinnati
Leary, Thomas W., Akron
•MacAulay, Robert W., Cincinnati
Meacham, Howard C., Jr., Columbus
•Merritt, William L., Cincinnati
Mueller, Edwin L., Cleveland
Spencer, Peter D., Cleveland
Tolson, Owen T., Jr., Mount Vernon
Yaeger, William H., Cleveland

Oklahoma

Middleton, James A., Sr., Tulsa

Oregon

Bullwinkle, Benjamin B., Portland

Pennsylvania

•Ashton, Edwin C., Jr., Downingtown
Aylikci, Veli, Erie
•Becker, Albert E., Jr., Milmont Park
•Haentjens, Walter D., Sugarloaf
•Hawman, Harry E., Shillington
Herchenroeder, Louis W., Pittsburgh
•Kane, Thomas R., Havertown
•Miller, Donald F., Pittsburgh
Pelc, Joseph F., Pittsburgh
Sciarra, John J., Lester
Siegel, Melvin A., Pittsburgh
Steer, John A., Philadelphia
Taylor, Edward G., Pittsburgh
Taylor, Robert L., Ridley Park
Tracy, William J., Pittsburgh

Rhode Island

•McCarroll, Berton S., North Providence

Tennessee

•Hale, James W., Manchester
Miller, Edward C., Oak Ridge
•Smith, John W., Kingsport
•Speas, Irvin G., Oak Ridge

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

Please Print

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LAST NAME _____ FIRST NAME _____ MIDDLE NAME _____

POSITION TITLE _____ NATURE OF WORK DONE _____

e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) _____ Division, if any _____

*☐

EMPLOYER'S ADDRESS _____ City _____ Zone _____ State _____

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER, e.g. Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc

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☐ Mechanical Engineering	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
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☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
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☐ D—Materials Handling	☐ M—Production Engineering	☐ V—Gas Turbine Power
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ W—Wood Industries
☐ F—Fuels	☐ O—Lubrication	☐ Y—Rubber and Plastics
☐ G—Safety	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ H—Hydraulics	☐ Q—Nuclear Engineering	
	☐ R—Railroad	

Texas

EICHELMANN, JOHN F., El Paso
●JACKSON, TAYLOR H., El Paso
●KAPPELE, JEROME A., Baytown
NEFF, RAY Q., Pasadena

Utah

BENFORD, GEORGE S., JR., Ogden

Virginia

PEIRSON, SAMUEL, III, Fort Belvoir
RINEHART, JAMES W., Richmond
●ROBERTSON, LEMUEL C., JR., Newport News
TAYLOR, DAVID G., Norfolk
WAGNER, WILLIAM B., Yorktown

Washington

HO, BIN-LUN, Seattle

Wisconsin

AUSTIN, STANLEY M., Hales Corners
●MYERS, HOWARD E., Milwaukee

Foreign

●FLORES, ANACLETO G., Mexico, Mexico
HASBACH, GUILLERMO E., Mexico, Mexico
KRUGER, PAUL E. A., Köln-Dellbrück, West Germany
SINGH, TARA, Bangalore, India
TUPPER, KENNETH F., Toronto, Ont., Canada

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[Agency]

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When making application for a position include eight cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

NEW YORK	CHICAGO	DETROIT	SAN FRANCISCO
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Men Available[1]

Consulting or Research Engineer; PhD; 33; six years teaching and research in the field of heat transfer, fluid flow, thermodynamics; two years in nuclear component industry. Prefers East, West, or Midwest. Me-607.

Utility-Operation Engineer; 45; 25 years training personnel in operation of maintenance-safety programs for turbo-electric boiler plant; familiar all known fuels, temps, pressures. Location, optional. Me-608.

Mechanical Engineer, BSME; 25; 1½ years' experience in plant engineering. Prefers New York metropolitan area, or Philadelphia, Pa. Me-609.

Quality-Control Manager; BSME; 49; eight years in manufacturing engineering; 20 years in quality control, 12 of these as quality-control manager, in refrigeration, air conditioning, electric motors, and electronic fire-control equipment. Location, immaterial. Me-610.

Sales Engineer or Sales Manager; BS(ME), PE (NJ); 39; 15 years' experience sales, engineering, estimating of industrial metal buildings, building products, and ship construction; also well experienced management and office procedures. Has car. Prefers northern N. J. Me-611.

Heat-Transfer Designer; BSME; 25; one year's experience in design of heat-transfer equipment for mills and plants. Prefers N. Y., Pa., or Calif. Me-612.

Designer, Mechanical Engineer; MS; 40; stress analysis, manufacturing, cold-storage warehouse construction, operation research, for a total of ten years' experience. Location immaterial. Me-613.

Plant or Maintenance Engineer; BSME; 34; five years' experience in selection, design of plant improvements, and additions. Working knowledge of Spanish. Desires plant or maintenance-engineering job in Latin America. Me-614.

Vice-President or Director, Manufacturing Services; BSME, MSME, PE; 38; 16 years' top-level experience in layout, design construction, and operation of industrial and commercial facilities. Held positions as assistant to vice-president, chief engineer, and consultant. Prefers East, South, West. Me-615.

Engineer; MS; Business and Engineering Administration; 11 years' experience in manufacturing and production engineering, quality control, and management. Me-616.

Dean, Engineering College; BSME, MSME; 39; five years as associate professor, mechanical engineering; six years department head in ECPD accredited institution. Responsible industrial experience. Seeks opportunity to promote up-to-date engineering-educational standards and to expand facilities in a progressive, academic environment. Location, immaterial. Me-617-893-Chicago.

Process Engineer; MSME, ME; registered; 37; 12 years' experience in process and utilities design, supervision, and co-ordination of major projects. Presently employed as senior engineer; seeks European or Middle East position. Languages. Me-618.

Chief Industrial Engineer; BSME; 40; registered; three years large-scale electronic computer; 12 years general industrial engineering, i.e., light and heavy manufacturing including supervisory assignments. Prefers Midwest. Me-619-9810-Detroit.

Executive Engineer or Manager; BSME; 53; 25 years supervisory, management positions in engineering development, distribution, and production of internal-combustion engines, superchargers, compressors, and turbomachinery. Organized new divisions, improved products and operations. Prefers West Coast. Me-620-894-Chicago.

Development Engineer; BS; 40; 15 years' experience applied research and product development mechanical and electromechanical devices. Possesses intellectual curiosity combined with background of practical experience. Acquainted with related problems of design, sales, manufacturing. Prefers West and Southwest. Me-621-895-Chicago.

Systems-Procedures Engineer; BS Business Administration; 52; 15 years' corporate-level plant and consulting experience in design, installation, and management with particular reference to production and inventory control, including stores organization, warehousing, layout and material handling, much financial analysis, and management planning. Location, immaterial. Me-622.

Mechanical Engineer; BS, MSME; registered; 36; responsible background in analysis, design, development, application; four years automotive involving heat transfer, fluid flow, thermodynamics; six years air conditioning, refrigeration, heating, and other mechanical systems; one year sales. Studying nuclear engineering. Prefers Midwest. Me-623-9814-Detroit.

Test-Facilities Engineer, Developmental Pilot Plants; 41; 15 years' practical, cost-conscious experience record in plant engineering and engineering construction on power, industrial, atomic and missile plants, and facilities. Registered ME in N. Y. and Calif. Seeking challenge and growth. Presently located in Calif. Me-267-San Francisco.

[1] All men listed hold some form of ASME membership.

Positions Available

Designer; mechanical graduate, at least three years' experience on design and layout of special machinery and equipment for die casting, light forging, and metal-stamping products. $7000–$8500. Pa. W-6267.

Assistant Plant Engineer, not over 30, graduate mechanical or electrical, to assist plant engineer in regular plant-engineering work; design new facilities and engineering facility improvements and assist in the supervision of plant-maintenance work. Position will lead to that of plant engineer. Salary open dependent upon amount and type of experience. La. W-6287.

Senior Production Engineer, at least eight years' precision metal-products design and manufacturing experience, to take charge of air-powered tool project. $10,000–$12,000. East. W-6288.

Engineer, university graduate, at least five years' experience in the operation of steam-electric generating station for responsible position. Preference will be given to Spanish-speaking applicant. Salary dependent upon qualifications. South America. F-6293.

Assistant Associate Professor of Engineering Administration, master's or PhD preferred. Should have a combination of industrial-management and teaching experience. Opportunity for consulting research in this field. $6500–$8200. East Coast. W-6294.

Engineer-Estimator, 30–35, preferably degree in mechanical engineering, to prepare estimates and quotations working directly from blue-prints. Will design or assist in design of tooling equipment (patterns, core boxes, etc.) for production. Must have ability to read complex blueprints; high degree of interest and aptitude in mechanical design (for production tooling). Salary open. Upstate N. Y. W-6301.

Designer; graduate mechanical, under 40, ten years' experience on heating, ventilating and air conditioning, and plumbing. $13,200. Europe. F-6302.

Engineer; 27–32, at least a bachelor's degree in mechanical engineering, associated engineering sciences, or physics; experience either in an industrial organization or government service along the lines of materials engineering, product engineering, design or as an information officer in guided missiles and rockets or related experience. Will work with a group whose interest includes deterioration of materials and equipment and its prevention. Some travel; security clearance through "Secret" required. $7000–$7500. East. W-6303.

Mechanical Engineer; graduate, young, three to five years' experience, preferably in production, on the manufacture of steel, wood, and plastic truck-trailer boxes and containers. Will also work on maintenance of equipment handling cargo and freight. $10,000–$15,000. New York, N. Y. W-6305.

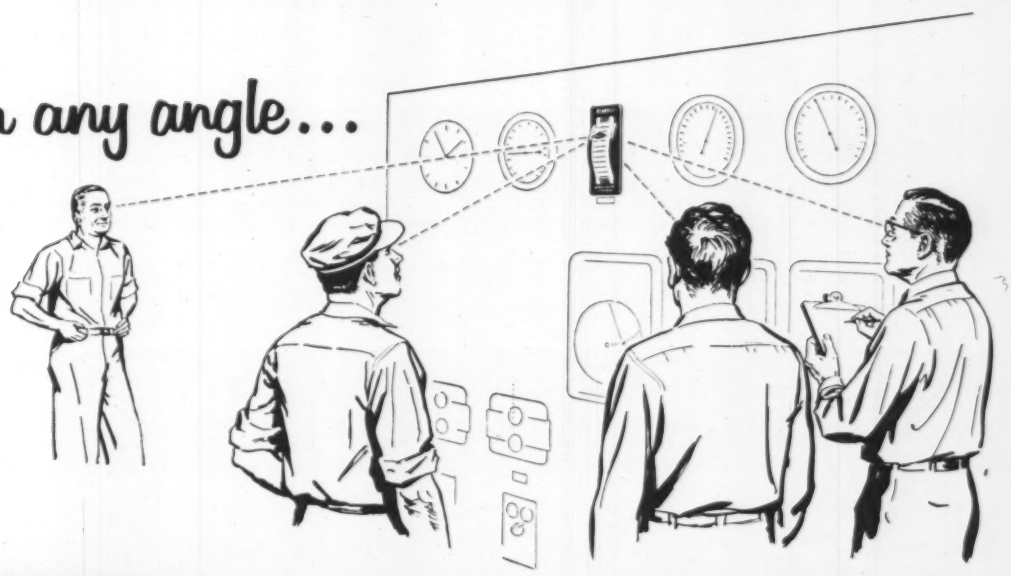
Materials Specialist; broad background in all types of materials, including plastics, metallic, ceramic, etc. Should be familiar with new developments in materials field. Should be capable of studying present and projected needs of appliance business and determining ideal characteristics for materials to answer needs. Will serve as consultant on materials problems to various research groups. Advanced degree desirable. Salary open; plus bonus. Mich. W-6309.

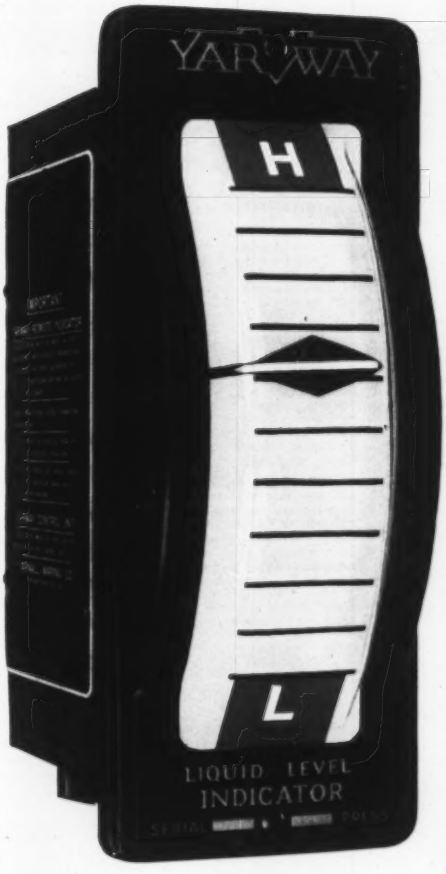
Trainees, Mechanical Engineers. (*a*) Field engineer, sales, 25–30, graduate mechanical, to work as application engineer in sales office until given a field assignment. Will be trained for three months at main plant, three months in district office, and six months at main plant. $4800–$5400. (*b*) Design engineer, graduate mechanical, thorough knowledge of thermodynamics and graduated in the upper quarter of class. Must be interested in creative engineering. Will be trained for six months and then become a design engineer; can progress to project engineer. Not a board job. $4800–$5400. Applicants must have completed military service. Midwest. W-6313.

Application Engineer, Sales; 25–35, ME degree or equivalent, two to four years' experience in the gas-utility field in an engineering capacity. Must have a sales personality. Will work three to four years as an application engineer in factory-meter-sales department, with an

(*ASME News continued on page 142*)

from any angle...





BOILER WATER LEVELS ARE EASIER TO READ with YARWAY INDICATORS

No matter where you stand, you can see at a glance your boiler water level in the Yarway Remote Liquid Level Indicator. The clear, "wide vision" face permits easy readings from any point in a 180° arc.

Readings are instant and accurate because the operating mechanism is actuated by the boiler water itself—by the pressure differential between a constant head and the varying head of water in the boiler drum. Pointer mechanism is never under pressure.

Yarway Remote Indicators are available fully compensated for every change in boiler temperature and pressure and they can be connected to Electronic Secondary Indicators or remote Hi-Lo Alarm Signals (lights or horns), located at any other point in the plant. Also available, Yarway Recorders working on same simple principle.

Over 12,000 Yarway Remote Indicators already installed.

Write for full details on Yarway Indicators for boilers, heaters and other applications. Bulletin WG-1824 tells all, shows typical hook-ups.

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BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY

...a good way to specify remote liquid level indicators

opportunity to become field engineer or specialist on meters, then to chief application engineer. $5280–$6540. Midwest. W-6314.

Designer, Reciprocating-Compressor Cylinders; at least 10 years of responsible and successful experience in the design of reciprocating-compressor cylinders. Cylinders are for compressing a wide variety of gaseous products at pressures ranging from vacuum to 15,000 lb per sq in. Salary open. Midwest. W-6322.

Chief Tool Engineer, 30–50, degree desirable. Experienced in heading or press for all tooling functions. Will maintain close liaison with all production activities. Responsibilities include procurement, estimating, and development functions. $9000–$13,000. Pa. W-6323.

General Sales Manager, 35–50, chemical or mechanical-engineering training, to manage sales department of a multiproduct, multidivisional sales organization of high-unit-value capital equipment or services to process and metallurgical industries and U. S. military services. Must have demonstrated experience as sales manager—responsibility for direction of policy determination, pricing, forecasting, market development, and other functions of a general sales office. Should be familiar with chemical and petrochemical processing industry, process machinery and equipment, power machinery and equipment, etc. To $22,000. East. W-6326.

Engineers. (*a*) Manager of operations, 35–50, graduate engineer or equivalent, to manage operating divisions of a multiplant national corporation engaged in bulk-fluid chemical continuous processing; will supervise approximately 500 people in 20 plants located on the East and West coast. Will be responsible for operations, maintenance, distribution, profitability, industrial relations. Most of professional career must have been associated with operations of the chemical, petroleum, or process industries with progressive responsibility to management level. Should be familiar with chemical-engineering-unit operations and processes, compressors, pumps, motors, turbines, engines, and process machinery and equipment. Extensive interplant, national travel required. To $22,000. (*b*) Manager of construction, to 50, graduate engineer, experienced in planning and directing complete construction of chemical-process plant, to manage and supervise multiproject chemical plants, captive engineering and construction division. Must have a successful record of "getting the job done" in chemical or petroleum-refining-plants construction field. To $18,000. East. W-6327.

Management Personnel. (*a*) Manager, Manufacturing Division, 36–48, graduate engineer, experience in heavy equipment manufacture, to supervise operations of a multiplant manufacturing organization of approximately 1500 employees which serves as a captive supplier to an integrated engineering, construction, and sales organization. Equipment experience should include several of the following: pressure vessels to ASME Code standards, heat-transfer equipment, weldments, or blowers, sheet metal, and structural assemblies. To $22,000. (*b*) Manager of machinery engineering, 35–50, BS, MS, or PhD in mechanical engineering, at least 12 years' experience in design, manufacture, and application of rotating and/or reciprocating machinery, broad understanding of engineering and shop practice combined with knowledge of commercially available domestic and foreign equipment in this field. Will manage an engineering group for company engaged in the field of continuous bulk-fluid chemical processing. To $18,000. East. W-6328.

Director of Research; PhD in mechanical engineering an absolute requirement; 35–50, some knowledge of servomechanisms, calculating machines. Will head up a group of ten people on applied research. $13,500, plus bonus. Conn. W-6329.

Mechanical Engineers, to 45, BSME, for component engineering involving valves. One to ten years' experience in the fields of hydraulic operated valves, solenoid valves, air-operated and the standard manual hand-check valves is desired. Knowledge of design principles, fabricating procedures, and materials selection is required. To $9000. Pa. W-6332(*a*).

Quality Engineers, to 45, BSME or MetE, or equivalent experience, with five to ten years' experience. (*a*) Quality-control engineer to follow pressure vessels. Knowledge of pressure-vessel fabrication necessary. Use of ASME Boiler Code and welding application. Liaison with vendors. Willing to travel anywhere. (*b*) Quality-control engineers to follow valves. Experience in heavy machining and assembly, preferably on valves. Heavy manufacturing experience. Knowledge of welding necessary. Liaison with vendors. Free to travel. (*c*) Quality-control engineers to follow pumps. Experience in pumps, forging and/or shop experience necessary. Will follow metallurgical requirements of castings or forgings. Vendor liaison. Knowledge of welding necessary. To $7800. Pa. W-6333.

Development Engineer II; 30–45, graduate mechanical or electrical, three or more years' experience in mechanical-development work. Experience in textiles desirable but not required. Will assist in research on planning and development of new machinery and the improvement of existing machinery. Assignments are essential project type with full responsibility for completion. Salary open. South. W-6336.

Manager, Package Plant; to manage all operations of a package plant to ensure that changing product-inventory levels are maintained with packages of prescribed quantity and specifications at optimum cost. Will develop long-range programs consistent with those of plant and production department; establish objectives and develop measures for machine performance; maintain a continuing review of package-plant performance, effectiveness of plan of organization and operating methods, etc.; direct packaging of products, etc. Salary open. New York metropolitan area. W-6341.

Senior Research Engineer, Systems Management, and Engineering, MS (ME), EE, or mathematics, with ten to 15 years' experience which must include mathematical analysis, design and application of gyros and stable platforms, servo control, hydraulic and electromagnetic actuators, and general instrumentation-type of mechanical design. Will assume full program responsibility for the development of airborne-stabilization systems of extreme accuracy as regards steadiness and position; will encompass all phases from proposal and estimating to final delivery of completed hardware, including study, analysis, design, fabrication, and testing. Salary open. New York suburban area. W-6347(*b*).

Design Engineers, Systems Management, and Engineering, BSME preferred; however college-level course in electronics, mechanics, mathematics, machine design acceptable; five to eight years' experience in electromechanical instrumentation design. Good knowledge of machining operations, stampings, forgings. $8320–$8840. New York suburban area. W-6348.

Chief Development Engineer, 35–45, mechanical graduate, considerable experience in the design and development of high-speed automatic machinery as used in paper-converting business. Paper experience desirable but not a prerequisite. Some control-system experience desirable. $14,000, plus bonus. Mich. W-6352.

Instructor in Field of Mathematics; prefer a man with a doctorate but one with master's degree will be considered. $4500–$5500, nine months. Available September, 1958. Mo. W-6357.

Product-Development Engineers, 26–35, BSME or BSEE, graduate work desired; with two to six years' experience in product development; research or prototype production of small precision instruments or aircraft components. Knowledge of hydraulics, pneumatics, fluid flow, and dynamics essential, preferably experienced in these fields. Will assume responsibility for certain projects in the development and early production stages of company's products. To start, $8500–$12,000. Company will negotiate placement fees and relocation expenses. Upstate N. Y. W-6358.

Chief Engineer; graduate mechanical, to 50, at least ten years' experience as assistant or chief engineer in plate and sheet-metal fabricating plant. Will be responsible for all engineering and design in plate-fabricating plant. Company employs about 570. Engineering department of eight to ten draftsmen and estimators. Must have worked with ASME codes. $10,000–$12,000, plus good fringe benefits; moving expenses paid. Employer might negotiate placement fee. Colo. C-6925.

Designer, Heating, Ventilating, and Air Conditioning, mechanical background, to 45, recent good experience in all phases of heating, ventilating, air conditioning, and some plumbing; up-to-date on equipment methods, preferably currently working at this task. Will design, lay out, and supervise drafting; assist in preparation of specifications; be able to develop a system for components; know codes; Position is with a well-established architectural, engineering, structural, and mechanical consultant on commercial, public, and light industrial building. $120–$150 a week, plus general benefits. Central Valley, Calif. S-3652.

Engineers, mechanical or electronic, with good experience in design and development of electromechanical equipment for: (*a*) Development of electronic and air-data systems for aircraft; (*b*) servomechanisms and magnetic amplifier-control devices; (*c*) development and testing of nonelectric flight instruments and controls; (*d*) design of light mechanisms for production. Considerable experience desirable for key positions. Salaries open. Southern Calif. S-3653-R.

Superintendent of Construction, general construction, building background, well experienced in co-ordinating crafts and trades, primarily mechanical, for general contractor. Knowledge of cafeteria-type construction, masonry frame, and simple foundation and ground work helpful. U. S. citizenship required. $150–$160 a week; temporary, six months. Alameda County, Calif. S-3654.

Design Engineer, Steel Machinery, preferably BSME, 28–45, experience designing and detailing metal fabrications, buckets, conveyers, etc. Should know cutting, forming, and welding operations. Position with manufacturer of equipment for placing and finishing concrete. Prefer U. S. citizen. Salary open. East Bay, Calif. S-3665.

Sales Engineer, Mechanical Equipment, graduate engineer preferred, to 35, two to five years' experience working with a manufacturer, consultant, or contractor in engineering, application, usage, or sales of mechanical equipment for use in power, process, steam plants. Will work as assistant, office and outside duties, to learn business with organization selling and installing boiler plants. Base salary, plus bonus. San Francisco, Calif., with possible relocation to Seattle, Portland, or Vancouver. S-3666-R.

OBITUARIES

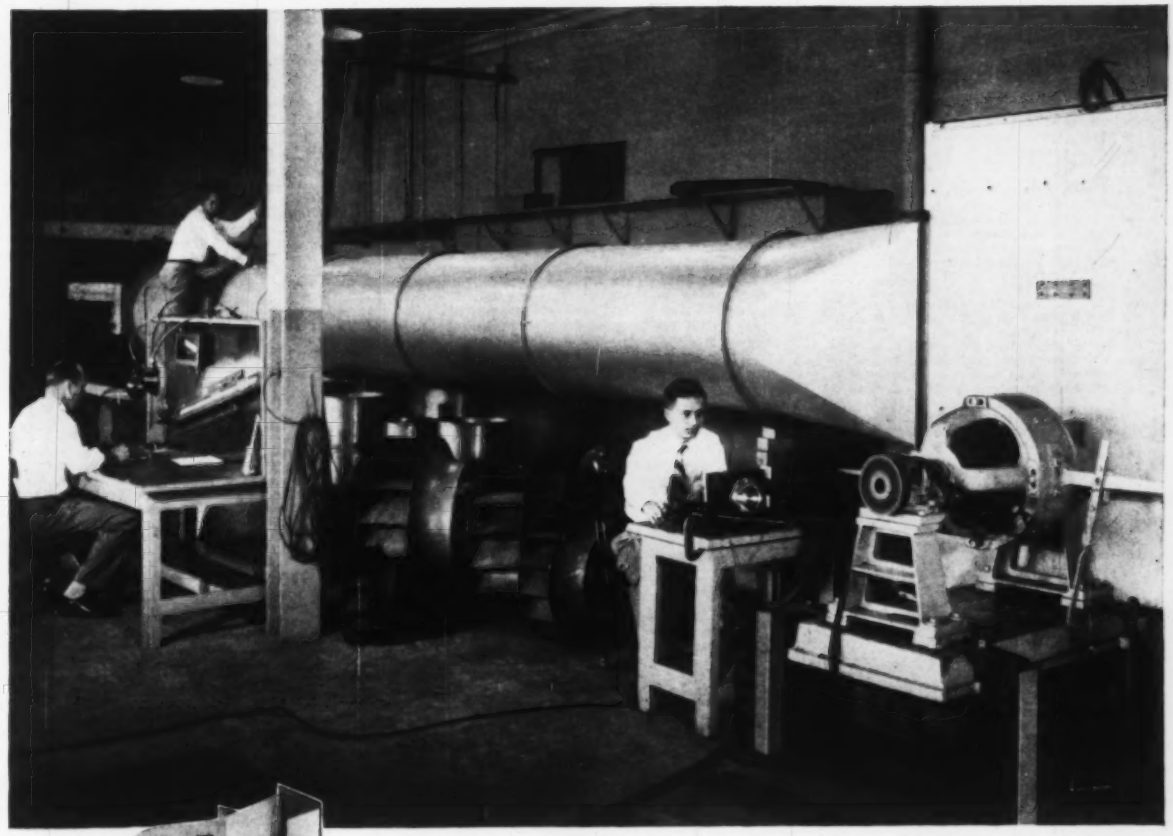
Jean March Allen (1878–1958), consulting engineer and naval architect, Los Angeles, Calif., died April 12, 1958. Born, Green Bay, Wis., May 27, 1878. Parents, James A. and Zada (March) Allen. Education, two years special study at the University of Wisconsin. Married Diann Freeney, 1900. Mem. ASME, 1913. During his career of over 50 years, Mr. Allen designed more than 80 dredges of various types, clam shell, dipper, hydraulic; and of various sizes from 6 to 30-in.; and powered by gas engines, steam, steam turbines, and such. He had executive or supervisory charge of dredging contracts aggregating approximately 150-million cu yd. These contracts covered dipper, clam shell, and hydraulic dredging and earth and rock excavation on inland and tidal waters. Mr. Allen was a Spanish-American War veteran. During World War I, he was resident inspector of the Chicago District for the United States Shipping Board. Prior to World War II, he was with the U. S. Maritime Commission as principal machinery inspector at the California Shipbuilding Corporation, Terminal Island, Long Beach, Calif. He was a registered professional engineer in the State of California. He was the author of numerous articles on the subject of dredging and dredging operations.

Frederick Stephen Ball (1907–1958), president, Franklin Balmar Corp., New York, N. Y., died April 21, 1958. Born, Philadelphia, Pa., June 6, 1907. Parents, Frederick Michael and Helen (McGee) Ball. Education, three years of engineering study, Harvard University. Married Wilhelmina K. Holman, 1938; three children, Stephanie L., Frederick S., III, and Andrew M. Ball. Mem. ASME, 1946. Prior to his association with Franklin Balmar Corp. in 1955, Mr. Ball had been a senior railway engineer with SKF Industries since 1935.

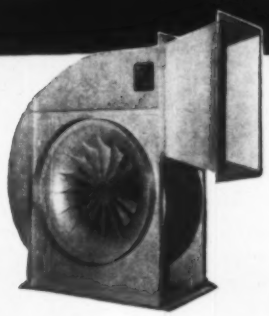
Robert Edward Brandt (1923–1958), project engineer, Atomic Products Div., General Electric Co., San Jose, Calif., died May 7, 1958. Born, Beatrice, Neb., March 25, 1923. Education, BS(ME), University of Nebraska, 1949. Assoc. Mem. ASME, 1949. Formerly he had been with the General Electric High-Voltage Laboratory, Pittsfield, Mass. Member Sigma Xi, Pi Tau Sigma, and Sigma Tau. Survived by his widow Shirley E. Brandt; and two sons, Edward and Steven.

Ernest G. de Coriolis (1882–1958), director of research, Surface Combustion Corp., Toledo, Ohio, died May 18, 1958. Born, Port Louis, Mauritius Island, Aug. 16, 1882. Parents, Baron Gustave and Baronne Laure de Coriolis. Education, attended Royal College, Mauritius Island (affiliate Cambridge University,; BSA, University of Toronto, 1903; postgraduate study, McGill University, Montreal, Canada; and University of Illinois. Naturalized U. S. citizen, Boston, Mass. 1924. Married Hilda Katherine Fuller, 1909; five children, Cecile, George, Louis, Pierre, and Marie-Louise. Mem. ASME, 1921; Fellow

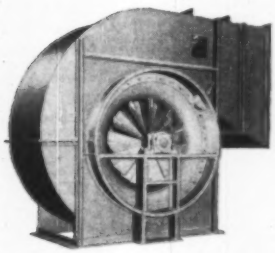
(*ASME News continued on page 144*)



Complete Test Setup at "Buffalo" to Check Fan Wheel Performance Over Entire Range of Operation.



92% Mechanical Efficiency — attained by the "Buffalo" Airfoil Fan.



"Buffalo" Type BLH Fan for Classes II - IV air handling.

WE PAY THEM NOT TO BE SATISFIED —SO THAT YOU WILL BE!

Fan designing and testing at "Buffalo" are jobs that are never "completed" — because once an improved model tests out, our engineers go back to work on a better one!

That's the spirit of dissatisfaction which developed the series of "Buffalo" Airfoil and Semi-Airfoil Fans with choice of wheels to match widely varying requirements — the Types BL and BLH Fans to cover all pressure classifications. And though these fans have set new records for efficiency and stable performance, the work still goes on toward even higher goals. Meanwhile, you get the benefits: the best of hundreds of tested fan designs — the most complete selection of fans for the exact performance you require — the *"Q" Factor or built-in Quality which provides trouble-free satisfaction and long life.*

Write for Bulletins F-200 and FD-106. See why "Buffalo" means a better fan buy.

BUFFALO FORGE COMPANY
BUFFALO, N. Y.

"Buffalo"

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

ASME, 1954. Mr. de Coriolis had been with Surface Combustion since 1925. In that period he was closely connected with the company's many significant contributions. Among these are: The gas-fired radiant tube for controlled atmosphere heating; development of prepared atmospheres for gas carburizing; the development of continuous automatic processes for the production of fuel gas from a variety of hydrocarbon materials; and many others. Prior to joining Surface Combustion, he had, for a number of years, been active in the field of chemical engineering. In that period, he had been chief engineer with Arthur D. Little, Inc. He had contributed many papers to scientific and technical journals; and held 16 patents pertaining to fuels and furnaces in industry. The Toledo Technical Council named him Engineer of the Year in 1957. He received the Trinks Award, the highest honor of the industrial heating industry, in 1956. During World War II, he received honorable mention from the National Metal Trades Association for his development of a gas generator used in the manufacture of war material. He was a cofounder of the Toledo Society of Professional Engineers. From 1932 to 1934, he had been chairman of the Toledo Section of ASME. Registered professional engineer in the State of Ohio.

Oliver Jones Egleston (1877–1956), retired vice-president, United States Smelting, Refining, and Mining Co., San Francisco, Calif., died Aug. 23, 1956. Born, Wykoff, Minn., Aug. 21, 1877. Parents, Marvin and Hannah (Jones) Egleston. Education, Minnesota School of Mines, 1900. Married Florence Plimpton, 1907. Mem. ASME, 1916. Mr. Egleston had been with United States Smelting, Refining, and Mining Co. since 1901 when he started as a draftsman. Survived by his widow; and two sons, Marvin P. Egleston, Murray, Utah; and Willis E. Egleston, Wellesley Hills, Mass.

Warren Dobson Gale (1890–1958?), whose death recently was made known to the Society had been retired in Waterville, Quebec, Canada, since 1944. Born, Waterville, Quebec, Canada, Oct. 15, 1890. Education, attended Toronto University and Columbia University. Assoc-Mem. ASME, 1914; Affiliate ASME, 1926. From 1925 until his retirement, Mr. Gale had been associated with the American Book and Printing Co., S. A., Mexico, D. F. He is survived by his widow.

Robert Halsey Henderson (1876–1958), retired owner of the Henderson Electric Co., East Orange, N. J., died April 22, 1958. Born, Keokuk, Iowa, Aug. 4, 1876. Education, PhB, Northwestern University, 1902. Mem. ASME, 1907. Mr. Henderson had been manager of the Bloomfield plant of the Westinghouse Electric Manufacturing Company before he established his own firm in 1913. He retired in 1954. The holder of 14 patents, he was the inventor of the Henderson E-Z conduit benders and the Tubender for electric tubing. He was a member of AIEE. Survived by a daughter, Mrs. Dallas C. Akers.

Holger Hoiriis (1894–1958), consulting engineer, Engineers Associated, Berkeley, Calif., died Feb. 15, 1958. Born, Hurup, Denmark, May 12, 1894. Parents, Jens and Karen Knudsgaard (Petersen) Hoiriis. Education, BS(ME), Royal Polytechnical Institute, Copenhagen, Denmark. Naturalized U. S. citizen, Oakland, Calif., 1939. Married Helene M. Rönholt, 1923. Mem. ASME 1943. A specialist in machine design, Mr. Hoiriis had had many years of experience with several leading corporations before entering an independent consulting practice. He was a registered engineer in the State of California. Survived by his widow; and a daughter, Mrs. Karen Mower, Durham, N. H.

Percival Reynolds Hunt (1903–1958), consultant, Milton, Mass., died Jan. 14, 1958. Born, Hyde Park, Mass., April 10, 1903. Education, BS(ME), Northwestern University, 1926. Mem. ASME, 1953. Mr. Hunt had been a specialist in the field of industrial engineering. Before engaging in consulting activities, he had been associated with the Tubular Rivet and Stud Co., Inc., Wollaston, Mass. During World War II, he was with the United States Army, War Department, Boston Chemical Procurement Office. Survived by his widow, Doris B. Hunt.

Henry Wilson Ingle (1883–1958?), whose death recently was made known to the Society, had been an engineer in the glass-making-machinery industry, Hartford-Empire Co., Hartford, Conn. Born, Windsor, Conn., Nov. 17, 1883. Education, high-school graduate. Assoc. Mem. ASME, 1920; Mem. ASME, 1935.

Herbert Owen James (1896–1956), president, D. O. James Gear Manufacturing Co., Chicago, Ill., died Dec. 14, 1956. Born, Chicago, Ill., Aug. 1, 1896. Parents, David O. and Anna James. Education, attended Lewis Institute. Married Helen May Callaghan, 1920 (d. 1957). Mem. ASME, 1952. Mr. James had been with the Gear Manufacturing Co. since 1919 and had done work on the development of gearing and gear reductions and was instrumental in the design and construction of planetary, herringbone, helical, worm, and bevel gear combinations. Survived by five sons, Richard O., Donald L., David E., Daniel H., and Philip Q. James.

Emmart La Crosse (1886–1957), vice-president and director of engineering, Stone & Webster Engineering Corp., Boston, Mass., died May 13, 1957. Born, Washington, D. C., March 7, 1886. Parents, J. F. and Lillie (Wallace) La Crosse. Education, attended University of Tennessee and Lowell Institute; hon. DE, Tufts College, 1946. Married Clara F. Harner, 1909; two sons, Emmert and Edwin Robert La Crosse. Mem. ASME, 1921; Fellow ASME, 1952. Mr. La Crosse had an outstanding record of achievement based on his performance on a great many engineering projects, especially during World War II. Under his direction, Stone and Webster engineers worked on some of the largest ordnance and explosive plants ever built and furnished important consulting services to organizations in similar work. During wartime his staff was active in the synthetic-rubber program and other similar projects. Steel foundries, brass mills, machine and forge shops, a shipyard, chemical plants, food products and pharmaceutical plants, make up the list of designs directed by Mr. La Crosse. His signal contribution to World War II was the direction of Stone and Webster's engineering work for the atomic bomb project. His staff designed and placed in successful operation the University of Chicago's pilot plant which preceded the development of the plutonium process. Under his direction also, were engineering designs for the electromagnetic process, a multimillion-dollar plant at Oak Ridge, Tenn.; designs for the City of Oak Ridge; and a heavy hydrogen plant at Trail, British Columbia. His post-war work included supervision of more than 5-million kw of steam, hydro, and diesel-electric power generation, natural-gas lines, and manufacturing plants of many kinds.

Paul Barry Mulligan (1910–1958), president Paul B. Mulligan & Co., New York, N. Y., died May 2, 1958. Born, New York, N. Y., March 11, 1910. Parents, Frank J. and Elizabeth (Barry) Mulligan. Education, attended St. John's College, New York University, New York Stock Exchange Institute, and ICS. Married Aileen Wright, 1931. Assoc-Mem. ASME, 1935; Mem. ASME, 1942. A management consultant specializing in clerical efficiency studies, Mr. Mulligan founded his company in 1947 in partnership with the late Harold E. Talbott, former Secretary of the Air Force. Mr. Mulligan originated the idea for the company while working as a staff assistant with the United States Steel Corp. He had contributed a number of articles to technical journals. He served the Society as a chairman of the materials-handling group of the Metropolitan Section, 1937 to 1938. Surviving are two daughters, Aileen and Sharon; his father, Frank J. Mulligan; two brothers and a sister.

Martin Leonard Olson (1877–1957), retired director and co-ordinator, co-operative industrial course, Hyde Park High School, Boston, Mass., died Nov. 29, 1957. Born, Karlstad, Sweden, Dec. 4, 1877. Parents, Svante and Charlotte Olson. Education, BS, Boston Teachers College, 1927; attended Harvard Business School, Lowell Institute, and Boston University. Naturalized U. S. citizen, Gardner, Mass., 1899. Married Gertrude F. Crane, 1906. Assoc-Mem. ASME, 1914; Mem. ASME, 1919. Mr. Olson joined the Boston school system in 1912. He taught mathematics and mechanical drawing before becoming director of the vocational school. He retired in 1945. Mr. Olson had been a vice-president of the Hyde Park Board of Trade and member of the Board of Managers of the Hyde Park Y.M.C.A. Survived by his widow, Gertrude Crane Olson.

Charles Penrose (1886–1958), consulting engineer, Philadelphia, Pa., died May 16, 1958. Born, Philadelphia, Pa., Jan. 24, 1886. Parents, Walter Elliott and Emily (Thompson) Penrose. Education, BS, Princeton University, 1907; EE, 1910; LLD, Cumberland University, 1940; DE, South Dakota School of Mines and Technology, 1944; Litt D, Ursinus College, 1951; LHD, Whitman College. Married Beatrice d'Este, 1910 (deceased). Married 2nd, Virginia Carlisle, 1930. Mem. ASME, 1918. Dr. Penrose was associated with the Philadelphia engineering firm of Day & Zimmerman, Inc., since 1917, and served as a vice-president from 1932 to 1956. He was chairman of the Newcomen Society of North America and since 1947 had been president of the Newcomen Publications in North America, Kittery, Me. In 1934, he served as special consultant to the Federal Housing Administration. He was Cyrus Fogg Brackett lecturer at Princeton and Henry J. Fuller lecturer at Worcester Polytechnic Institute. He was the author of a number of books and pamphlets. Among his works were: "The Sands of Time," "George B. Cortelyou," "L. F. Loree," and "Newcomb Carlton." Surviving are his widow; three sons, John Rowan, Julian d'Este, and Charles Penrose; and a daughter, Mrs. Edmund Charles Tarbell, II.

Philip William Swain (1889–1958), consulting editor and retired chief editor, *Power*, McGraw-Hill Publishing Co., died April 27, 1958. Born, Westerville, Ohio, Aug. 26, 1889. Parents, Richard La Rue and Anna Elizabeth (Shuey) Swain. Education, AB, Syracuse University, 1911; PhB, Yale University, 1913; ME, 1915; hon. DE, Case Institute of Technology, 1947. Married Edith Florence Adair, 1917. Jun. ASME, 1916; Assoc-Mem. ASME, 1920; Mem. ASME, 1925; Fellow ASME, 1951. Mr. Swain, in over 30 years with *Power*, had written several thousand original articles and editorials on various phases of power engineering. In addition to the many articles, strictly technical in nature, he created a feature article under the pen name of George Edwards. He was the author also of the 40th anniversary history of the McGraw-Hill Book Co., published in 1949. The simplification of engineering language and the development of new and more efficient ways of conveying engineering information were among his primary accomplishments. As representative for all McGraw-Hill publications and as technical adviser for the Columbia Broadcasting System, he covered the Bikini atomic tests in 1946. In recent years, he had been a lecturer on the subject of the tests and atomic power throughout the U. S. and Canada. He was concerned also with the problems of young engineers and engineering students, and through his many articles sought to provide them with practical solutions. Prior to his association with *Power*, he had been an instructor in mechanical engineering at Yale, and sales engineer with Franklin Manufacturing Co. While an undergraduate, he had worked during summer vacations as a machinist; later, he continued to develop this skill as a hobby. During World War I, he served in France with the U. S. Army 303rd Field Artillery as a lieutenant. After his retirement in 1954, he acted as an independent industrial consultant in technical writing and speaking. At the time of his death, he was head of the advisory council of Stoetzel and Associates, a Chicago marketing and advertising firm. Mr. Swain had been assistant director of the former Office of Strategic Information in 1955 and also served with the Department of Air Pollution Control in New York. He had taught business journalism at Columbia University. As ASME Lecturer, in 1956, he delivered his talk, "Imagination —Key to Engineering Achievement," in local sections throughout the country. He was a member of Sigma Xi, Tau Beta Pi, and Sigma Delta Xi, and the Newcomen Society; as well as, AWS, the National Association of Power Engineers; and former eastern vice-president of the National Council of Business Editors. An expert yachtsman too, he was a member of the Riverside Yacht Club and the Royal Swedish Yacht Club. Survived by his widow; two daughters, Jean Adair Swain and Mrs. Hall F. Overton; two brothers, Judge Richard S. Swain of Bridgeport, Conn., and Stuart S. Swain of Cohasset, Mass., and a sister, Mrs. Arthur C. Preston, Wilbraham, Mass.

Donald Chase Voelker, Lt. (1931–1958), pilot, U. S. Navy, San Diego, Calif., was killed in an aircraft accident in April, 1958. Born, Woonsocket, R. I., July 2, 1931. Education, attended Brown University; BS, U. S. Naval Academy, 1953. Survived by his widow.

Maurice Elmo Weschler (1897–1958), head, department of mechanical engineering, The Catholic University, Washington, D. C., died May 2, 1958. Born, Oxon Hill, Md., May 12, 1897. Parents, Adam and Margaret (Howell) Weschler. Education, AB, St. John's College, 1916; BS(ME), The Catholic University of America, 1921; MA(ME), 1922; ME, 1923. Married Anne T. Lawrence, 1939; one son, Maurice Elmo, Jr. Jun. ASME, 1921; Mem. ASME, 1939; Fellow ASME, 1948. Mr. Weschler had been on the faculty of Catholic University since 1921. In 1942 he became head of the department of mechanical engineering. As a private consultant, he was responsible for engineering work in the construction of numerous government buildings in Washington. With his brother, the late George A. Weschler, he prepared the mechanical plans for the restoration of Williamsburg, Va. He had supervised work on the Supreme Court building and at the time of his death was helping plan future Federal building projects in the city. He also had acted as a consultant to the Navy's Bureau of Yards and Docks. During World War I, he served with the Army Engineer Corps. He had served the Washington, D. C., Section of the Society as secretary-treasurer, vice-chairman, and chairman, in the years 1932, 1934, and 1935, respectively; and until his death was active in the local section. From 1934 to 1940 he was honorary chairman of the Catholic University ASME Student Section. He had been director, vice-president, and president of the Washington Society of Engineers. Member Sigma Xi. Survived by his widow and son; two brothers, Andrew and Charles H. Weschler; and a sister, Katherine Weschler.

Eakin Lockwood Wheless, Jr. (1922–1957), rates engineer, Rate Division, Texas Eastern Transmission Corp., Shreveport, La., died Sept., 1957. Born, Shreveport, La., April 11, 1922. Education, BS(ME), Cornell University, 1947. Assoc. Mem. ASME, 1947; Mem. ASME, 1955. Mr. Wheless was a registered professional engineer in the State of Louisiana. He had been with Texas Eastern since 1948 and while there had been in responsible charge of design and development of new pipeline systems, compressor-station emergency-shutdown systems, and special equipment. He had been in charge also of studies of the company's gas-sales rates. In 1954, he was vice-chairman of the Shreveport Group of the Mid-Continent Section of ASME; and as such was partially responsible for its becoming a Subsection. In 1955, he was chairman of the Subsection.

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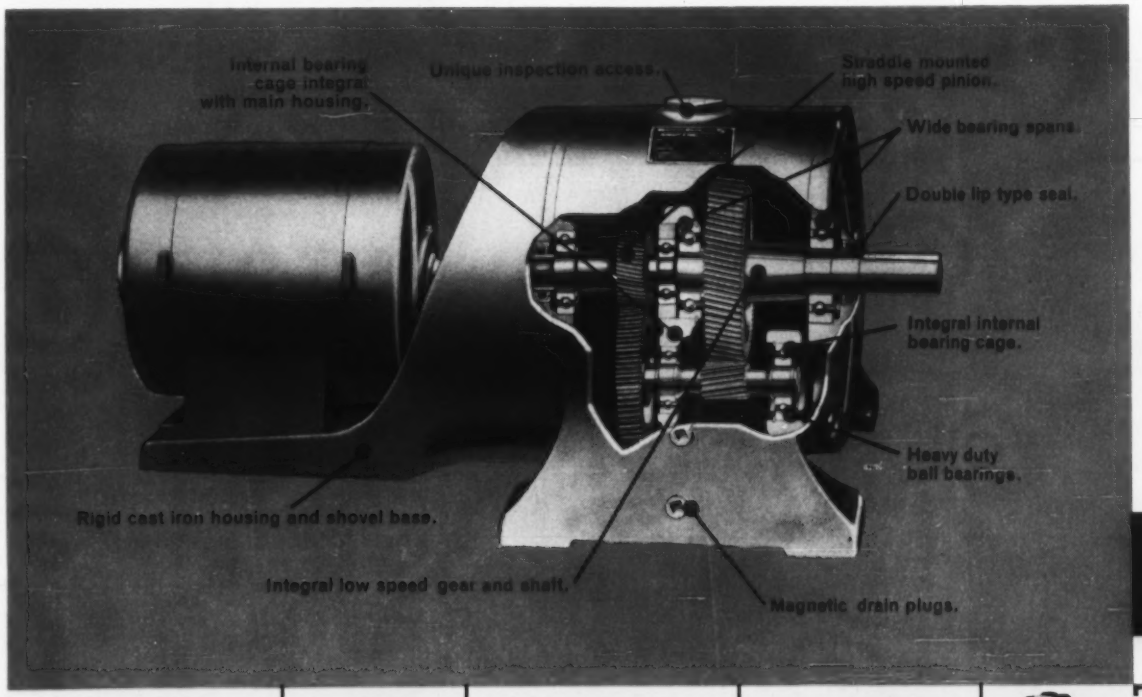
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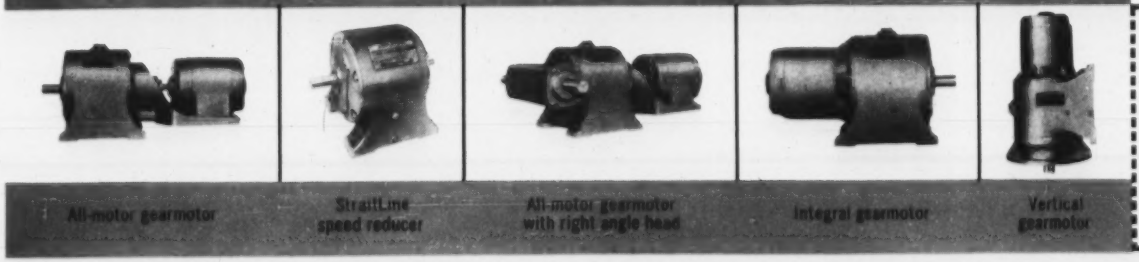

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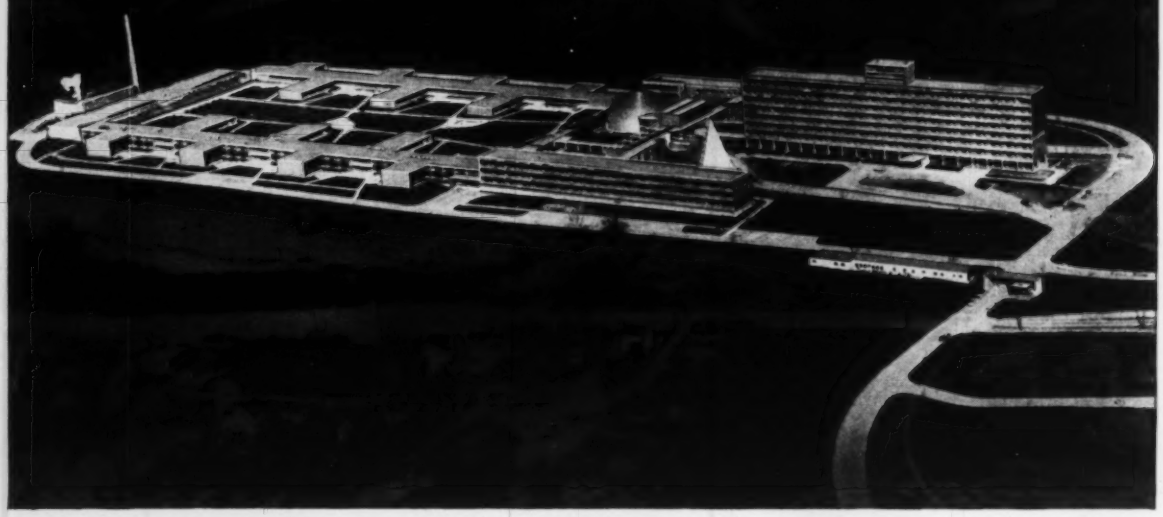

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No other valves have such a long record of efficient, low-cost service. To building experts and plant operating men, the Jenkins Diamond on a valve has been a mark of extra value for nearly a century. Yet the valves that bear this famous symbol cost no more. Jenkins Bros., 100 Park Avenue, New York 17.

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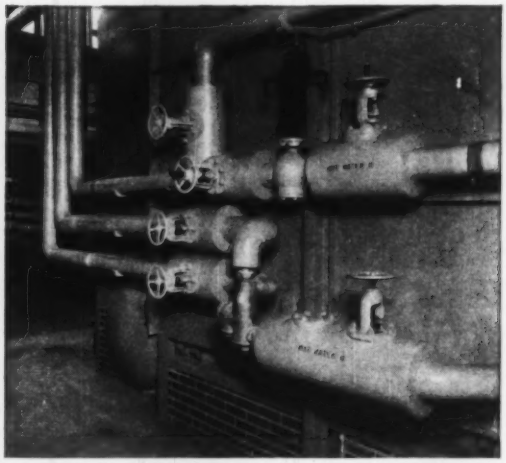

Among the varied types and sizes of Jenkins Valves are these Iron Body Globe and Gate Valves controlling high pressure feedwater.

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NEW EQUIPMENT

Snap-Action Switch

Haydon Switch, Inc. announces its 5300 series switch, a precision switch available with a range of operating forces from 2 to 20 oz.

The case is made of diallyl phthalate, a plastic with high strength and dimensional stability. Terminals are molded into the plastic cover and cannot wobble or be loosened under rough usage, the firm reports.

Two shapes can be furnished: the MS525085 configuration or the round base style. Because of its extremely small size, the round base style is particularly adaptable to ganging, for multiple switching in confined areas, the company says.

Special versions of the switch can be furnished for a wide variety of applications, the firm says. A high temperature model withstands 400 F continuous; another type has movement differentials as low as .001 in. —K-1

Curve Crown Pulley

Stephens-Adamson Mfg. Co. announces a new pulley, known as the curve-crown pulley, which is said to improve upon the features of the conventional taper crown and flat-face pulleys.

An absolutely round-rimmed pulley with a single seam, welded on both the outside and inside, the pulley is produced under a completely new forming process. The company says the crown of the pulley is accurately formed on the outer ends of the rim, providing maximum training effect but eliminating belt stretch and wear, usually prevalent with the conventional high-centered taper crown.

The new pulley also features a new squeeze-lock hub which transfers loads from shaft to hub and from hub to rim and yet eliminates weldments between hub and pulley end plates. In addition, the hub provides sufficient locking forces without the use of keyways, the firm states. —K-2

Dust Filter Bags

W. W. Sly Mfg. Co. announces new Resist-O-Wear three-section bags that are claimed to give as much as three times longer life as their predecessors. The units are now standard equipment in the firm's dust filters.

The new filter bag has two lengthwise seams which divide it into three equal-size pockets. Two rubber-coated inner spacers are inserted in each section, making a total of six per bag. Spacer weight is, the firm states, distributed on three seams, minimizing strain. Due to their smaller and stronger construction, the new inner spacers will last indefinitely, the company claims.

The firm reports that with the new bags, there are no outer spacers between bags, eliminating abrasion at these points while simplifying construction. A special protective flap at the dust chamber end of the bag is designed to provide extra reinforcement at this point, protecting against damage during installation and abrasion by incoming dust during operation.

The bags are made of special cotton sateen cloth with 104 × 68 thread count per sq in. to permit the free passage of air while retaining the finest dust particles. Each bag has a net effective cloth area of 22 sq ft. —K-3

Aluminum-Iron Alloys

Aluminum-iron alloys containing from 13 to 17 per cent aluminum (alloy containing approximately 16 per cent aluminum is referred to as 16-Alfenol) are announced by Metals & Controls Corp., General Plate Div., for applications requiring soft magnetic materials and core materials for high frequency applications.

Current and pulse transformers, relays, gyro mechanisms, signal generators, guidance systems, servo-mechanisms, microsyns are listed as applications of the alloys by the company.

Aluminum-iron alloys have magnetic properties equal to, or better than, 50 per cent nickel-iron or grain-oriented silicon iron, the firm reports. They also have low density, high electrical resistivity, low strain sensitivity, physical hardness, and good corrosion and oxidation resistance. The low density of aluminum-iron alloys makes a reduction in core weight possible when replacing nickel-iron and silicon-iron alloys, it is stated.

The alloys are available in strip form down to .010 in. thick and in widths up to 4 in. A minimum thickness of .005 in. can be supplied for special applications. —K-4

Aircraft Vacuum Pump

A new aircraft vacuum pump that requires no lubrication and discharges absolutely oil-free air is now available from Pesco Products Div., Borg-Warner Corp.

Designated Model 033612, the new unit has been designed as a direct replacement for the firm's Model 3P194, or equivalent, vacuum pumps. Applicable to all light aircraft equipped with vacuum instrumentation.

The new pump is lower in cost and lighter in installed weight than the 3P194 unit. Reductions in installed weight up to 25 per cent are achieved with the new design.

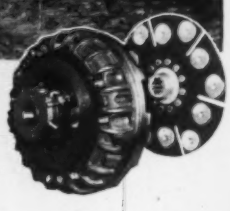
The unit is interchangeable with Model 3P194 regarding envelope, mounting pad, porting, fittings, torque and horse-power requirements, speed range, capacity and performance. Standard tooling and fixtures can be used to install the new pump on new engines or to convert existing installations. Discharge from the new unit can be direct to the atmosphere. Operation is much cleaner and eliminates a potential fire hazard.

Built in accordance with applicable military specifications, the vacuum pump is available in the standard design with ports having pipe threads or may be supplied with straight threads to comply with military requirements.

Also available is a tandem unit which has a female spline type power take-off. The firm says this design permits close-coupled mounting of a hydraulic pump for direct driving through the vacuum pump and eliminates the need for an additional engine gear box and engine mounting pad. The tandem model can also be obtained with either pipe or straight thread connections.

The new pump is an engine-driven, four-vane rotary, positive displacement type. Rated capacity is 4.5 cu ft of free air per minute at 1500 rpm with 4 in. Hg suction and 1 in. Hg pressure. Higher suctions and pressure deliveries can be obtained. Maximum recommended operating speed is 4500 rpm. —K-5

ROCKFORD



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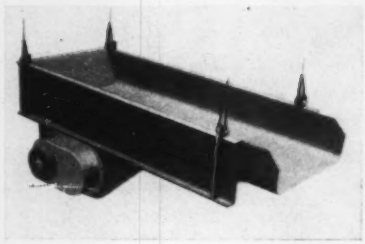

Vibrating Feeder

For controlled feeding of a wide range of bulk materials at high rates, Link-Belt Co. has announced its new straightline geared counterweight vibrating feeder.

It is claimed to be capable of absorbing great impacts. The new unit can be mounted directly under a hopper or bin to feed, convey, pick, or scalp high tonnages of materials, including lumps up to 36-in. in diameter. A geared eccentric shaft mechanism produces a high intensity straight-line stroke that ranges in amplitude from $^1/_4$ to $^1/_2$ in. up to 900 rpm.

According to the company, speed of the vibrator can be changed by adjusting variable speed belt drive. The hopper gate can be adjusted to control material depth and horizontal stroke can be adjusted to control material trajectory.

The feeder can be floor supported or suspended by cables from bins, tanks, or hoppers. It can also be equipped with such special features as dust-tight covers and scalping decks. As an aid to lengthening conveyor belt life, the new feeder can also be equipped with a short grizzly section that will permit fines to fall onto the belt first and in this manner cushion or pad the fall of heavy abrasive lumps. —K–6

Throttling Valve

A basic 2 in. valve body to which any combination of 13 interchangeable port-flanges can be attached by means of set screws has been added to the Universal line of precision throttling valves offered by Greer Hydraulics, Inc.

Five types of port-flanges, four of which are available in three line sizes for $1^1/_4$, $1^1/_2$, and 2 in. piping, provide a degree of valve flexibility previously possible only by means of special adapters and extra fittings. Available in these three line sizes are port flanges for threaded pipe, one-piece welded pipe, two-piece welded pipe and straight thread pipe with boss gasket and seal, as well as a $1^1/_4$ in. twelve thread Aminco type.

The valve meets JIC standards and is available for operating pressures to 7500 psi in light-weight aluminum bodies and for 10000 psi operating pressure in stainless steel valve bodies. —K–7

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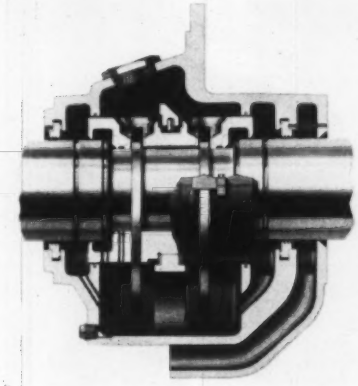

Bearing Enclosure

A capsule-type bearing enclosure used in connection with larger Allis-Chalmers motors has been adapted for the firm's Super-Seal line. The enclosure is designed to completely protect bearing surfaces and lubricant in any ambient.

The improved arrangement has a single opening in the capsule's upper half for oil-ring inspection. For maintenance checks, a bulls-eye sight glass is standard in all ratings. Rings can be checked without opening the weather-tight enclosure, the firm reports.

The bearing seal arrangement has been modified by reducing the number of separate bearing parts while maintaining an adequate oil seal. Two separate labyrinth sealing rings, both interchangeable for any given capsule size, are used.

Seals at each end are now an integral part of the bushing. Felt seals on shoulders inside the capsule bear circumferentially on each end of the bushing and form barriers to keep oil spary or vapors confined in the bearing area. A further seal at the back of the capsule is provided by shoulders machined for close clearance in the shaft.

Other mechanical features carried into the smaller motors include a pressure vent in the capsule which maintains neutral air pressure inside the bearing enclosure, a top-mounted breather, a sight glass for maintenance checks on oil level, and a device to prevent over filling of the bearing enclosure. —K–8

Tubing Swabs

A line of tubing swabs with interchangeable rubbers is announced by Byron Jackson Tools, Inc., Subsidiary of Borg-Warner Corp.

The new line features both cup type rubbers and the multi-disk type. A pair of either kind fits onto the streamlined two-piece body, the firm states, adding that the rubbers are designed for extreme flexibility of operation; they automatically adjust themselves to different loads. —K–9

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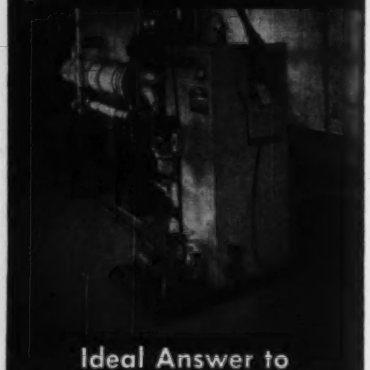

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Jet Water System

Deming Co., has announced the addition of a new fresh water packaged jet water system with a 4-gal tank for shallow well service.

The new system, called Fig. 4910-SWB, is self-priming and automatic. It has a capacitor type motor with a built-in thermatron for automatic reset and overload protection. The impeller is fully enclosed and accurately balanced. It has a stainless steel shaft and an all-brass ejector. A double pole pressure switch stops and starts the pump automatically.

The galvanized, bulb-type tank on the new pump is mounted directly on top of the pump. —K-10

Flow Control Valve

A new, low cost flow control valve, said to permit unusually precise control of air, gas, or low pressure hydraulic flow with unrestricted return is announced by Valvair Corp.

Known as the Micro-Trol, the new valve is reported to feature locked screw adjustment and a unique combination of controlling elements, a threaded stem, and molded nylon flapper. The lower range of flow rates is metered by adjusting the position of the ground cylindrical stem within a concentric bore in the valve body.

As the regulating portion of the stem clears the bore, the stem end contacts the flapper, lifting it off its seat. Flow is then controlled by the clearance between the flapper and seat. On return, the flapper lifts clear, affording unrestricted passage of the controlled medium. Flow rate adjustment is retained by an external lock nut on the slotted adjusting stem.

The valves are available in sizes ranging from $1/4$ through $3/4$ in. NPT. Flow area through the valve is said to exceed nominal rated pipe size. Valve body is of cast Navy M bronze, stem is stainless steel and the flapper is molded nylon. An O-ring seals and retains the stem. —K-11

VIGILANCE

The final victory over cancer will come from the research laboratory.

But there is a more immediate victory at hand today. Many cancers can be cured when detected early and treated promptly. *Vigilance* is the key to this victory.

There are certain signs which might mean cancer. Vigilance in heeding these danger signals could mean victory over cancer for you:

1. **Unusual bleeding or discharge.**
2. **A lump or thickening in the breast or elsewhere.**
3. **A sore that does not heal.**
4. **Change in bowel or bladder habits.**
5. **Hoarseness or cough.**
6. **Indigestion or difficulty in swallowing.**
7. **Change in a wart or mole.**

If your signal lasts longer than two weeks, go to your doctor to learn if it means cancer.

AMERICAN CANCER SOCIETY

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Pneumatic Relay

A pneumatic relay which solves equations continuously by combining two or more pneumatic signals in varying, predetermined proportions is now being manufactured by Bailey Meter Co.

The new relay multiplies or divides one pneumatic signal representing a measured variable by some predetermined function of a second variable. Standard unit also adds and subtracts pneumatic signals and provides proportional control action.

According to the company, the unit is suited to the ratioing of two flows in multi-element control systems, and to pressure-temperature compensation of liquid or gas flow measurement.

The computing relay uses standard SAMA ranges of 3–15 psig and 3–27 psig. Approximate size is $8\frac{1}{2} \times 11 \times 9$ in. deep. Function-generating cam is shaped on the job.

—K–12

Test Gage

Manning, Maxwell & Moore, Inc., announces the addition of a new test gage to its Ashcroft line of pressure gages.

It is designated Type 1080, and is designed for testing pressure instruments to 10,000 psi 0 to 30 in. vacuum, and 15 psi or 30 psi and 30 in. vacuum compound. It is available in 8 in. dial size only.

The unit, called Maxitest, comes in a light-weight aluminum alloy case with a handle at the top. It has a two-level, anti-parallax dial, finished in contrasting shades of green.

The company says a feature for increasing accuracy and ease of reading is the design of the unit's movable dial graduation tabs. These tabs have replaced graduations printed on the dial, and bear graduation markings on both sides of the exact reading mark. Reading 1, $\frac{1}{2}$, and $\frac{1}{4}$ per cent, they indicate deviations from standard reading in terms of per cent of total error. The tabs are positioned on the outer circumference of the dial at major dial graduation points. There are no intermediate dial graduations.

—K–13

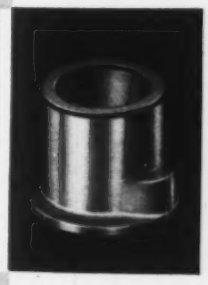
time to re-examine

BEARING APPLICATIONS

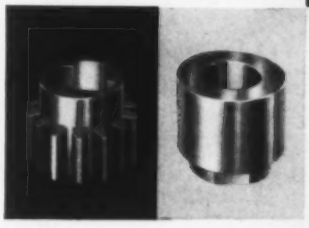
Striking cost reductions in bearing applications in many mechanical products are made possible by the use of Bunting Sintered Powdered Metal Bearings and parts.

Bunting engineering counsel can guide you in the selection of designs and alloys that will provide bearings of exactly the type, design and material that will fully meet both cost and functional requirements, whether the material be Cast Bronze or Sintered Metal.

A competent group of Bunting Sales Engineers in the field and a soundly established Product Engineering Department put at your command, comprehensive data and facts based on wide experience in the designing and use of Cast Bronze and Sintered Powdered Metal Bearings and parts.



Write for catalogs and your copy of the new 24 page Bunting Engineering handbook of Sintered Powdered products and their composition, manufacture and application.



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NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

Torque Checking

P. A. Sturtevant Co. announces a torque checking fixture, Model TCF100, designed to use torque wrenches ranging from 0 to 80 in-gr up to and including 0 to 100 in-lb.

The spindle is carried on selected instrument bearings and each torque checking fixture is inspected for torsional resistance before shipment. —K-14

Retaining Rings

Rotor Clip Co. is now marketing a series of size-identified retaining rings.

The firm says its units are the only retaining rings on the market with the ring size engraved on each piece. Every ring has a special tapered design for lower stress at the mid-section. The units are also available stacked on rods for automatic assembly operations. —K-15

Centrifugal Pumps

A line of standard centrifugal pumps for liquids which congeal, solidify, or crystallize with loss of heat is announced by Dean Brothers Pumps Inc.

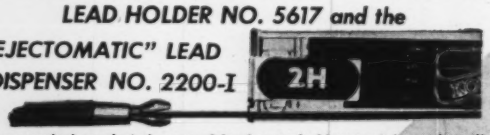
Labelled Constant Temperature pumps, they are designed to transfer heat to the liquid as it passes through the pump. The company says some of the liquids for which the new line is particularly useful are phthallic anhydride, sulphur, ammonium nitrate, rosin and urea. Waxes, tars, and heavy petroleum liquids and some fatty acids can also be pumped, the firm reports.

Heat transfer is accomplished by tracing of the casing and either tracing or jacketing the suction nozzle. The stuffing box is jacketed and the heat transfer medium is simply passed through this jacket to prevent possible solidification of pumped liquid in the packing or mechanical seal.

The pumps are available in either cast steel-iron fitted or all 316 stainless steel for parts coming in contact with the pumped liquid. —K-16

KOH-I-NOOR

THE KOH-I-NOOR ADAPTO-CLUTCH DRAFTING LEAD HOLDER NO. 5617 and the "EJECTOMATIC" LEAD DISPENSER NO. 2200-I



No more wondering what degree of lead your holder contains — just dial Indicator to the lead you have inserted to any one of the 17 degrees.

KOH-I-NOOR RAPIDOGRAPH NON-CLOGGING "TECHNICAL" FOUNTAIN PEN.

As easy to use as a pencil.

Excellent for drawing, tracing, inking-in, lettering and anything requiring reproduction. Uses either India, Drawing, or Fountain Pen Inks.

In 5 precision line widths

#00 Extra Extra Fine, #0 Extra Fine, #1 Fine, #2 Medium, #3 Broad. Color-coded caps for quick degree indentification.

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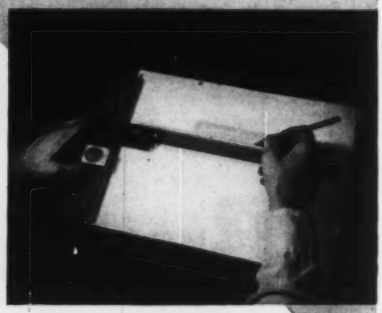
KOH-I-NOOR KOH-LINER NO. 3100 (12") NO. 3101 (19")

For rapid drawing of parallel lines. Set the dial for desired equi-distance, then just push the button and draw the line.

The 11 line spacings from 1/32" to 1/8" are automatic with full choice of in-between settings. Simple ruler adjustments regulate varying angles from 0° to 15°, 30° and 45° above or below the horizontal line.



KOH-I-NOOR PENCIL COMPANY, Inc.
BLOOMSBURY, NEW JERSEY

Flexible Brazing Sheet

Flexible sheet stock is the latest form in which Nicrobraz brazing alloys are available, according to an announcement from Stainless Processing Div., Wall Colmonoy Corp.

The new material, available in flexible sheets from 0.015 to 0.060 in. thick, is recommended by the company for use in brazed laminated sections and sandwich configurations of stainless steels, high alloys and titanium.

Brazing alloys now available in sheet form are standard Nicrobraz, L. M. Nicrobraz, L. C. Nicrobraz, Nicrobraz 10, Nicrobraz 30, Nicrobraz 45, Nicrobraz 50, Nicrobraz 60, Nicrobraz 130 and Nicrobraz 150. Sheets are available for all thicknesses in widths from 2 in. to 2 ft. Widths up to 1 ft are available in lengths up to 6 ft. Widths above 1 ft are available in lengths up to 2 ft. —K-17

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Wafer Bearings

A new series of bearings called Microwafers or wafer bearings has been custom manufactured by New Hampshire Ball Bearings.

They have been especially developed for synchros, servos, small motors, potentiometers and gear trains. In proportion to their outside diameters, wafer bearings have widths narrower than standard bearings.

Through the technique of through-boring, more iron and copper can be added to rotors and stators without increasing the over-all length of the unit. This allows greater capacity, and better performance can be built into existing designs, the firm reports.

The bearings are available in a variety of shaft and housing diameters. Available bore diameters range from .0937 to .1875. Housing diameters are from .2500 to .4375. All have the following characteristics: starting torque—standard at 1400 mg mm under 75 gm thrust 90 per cent guaranteed at 1100 mg mm if specified with lower levels by selection, material—440 C stainless steel; tolerances—ABEC 7 or better. —K-18

Portable Rotary Compressor

What is believed, by the company, to be the world's largest portable rotary air compressor manufactured to date is available from Le Roi Div., Westinghouse Air Brake Co.

The new 1200RD2 is a twin-unit rated at 1200 cfm of free air compressed 100 psi.

The firm says the twin-unit design of two-stage, oil-cooled, sliding vane type compressor powered by two GM 6-71 diesel engines, provides flexibility of cfm output presently not available on units near this size. It is mounted on a unit welded steel frame and four 7.50 × 20, 10-ply tires. Dry weight is 14,700 lb. Length is 14 ft 6 in.; height, to top of hood, is 8 ft; width is 7 ft 11 in., which is within limits of all existing state highway regulations. It has an 18-ft turning radius.

The twin-unit operates at rated output speeds of 1800 rpm for the compressors and 2000 rpm of the engines. The compressors are coupled to the engines with hydraulically actuated clutches. Each unit has a 100 per cent capacity control which matches air supply to air demands within a pressure range of 10 psi. One combination air receiver-oil separator is used.

Each unit has its own independent controls and can be operated separately for 600 cfm delivery or together for 1200 cfm delivery. The capacity controls are arranged so that each unit modulates separately or the two units modulate simultaneously. This allows one unit to be stopped when air requirements are 600 cfm or lower, or when servicing, without complete interruption of job operation, the company explains. —K-19

High Pressure Valve

A three-way solenoid-operated valve manufactured for aircraft and missiles and believed by the company to be smallest available is announced by Bridgeport Thermostat Div., Robertshaw-Fulton Controls Co.

Containing the exclusive captive seal, the valve measures 3.4 × 2.07 × 2.095 in. and weighs .77 lb. It is capable of handling pressures in excess of 3000 psi, the firm reports.

The $\frac{1}{4}$ in. valve is said to be suitable for use with various gases, and liquids including fuels and oils, as well as certain corrosive materials in a temperature range between 350 F. —K-20

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GENERAL PURPOSE
FANS
From design through maintenance, present day air handling problems demand BIG performance from fans. And General Purpose Fans do the job, give you that BIG performance. They're made in four types, 12 basic sizes, with capacities from 160 to 19,070 Cfm; in both constant speed units with direct connected motors and adjustable speed units with V-belt drives and integral mounted motors. Send for Bulletin 563.
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DOPPLER NAVIGATION EQUIPMENT is readied for flight testing under operational conditions. Engineers at the Maynard Laboratory hold responsibility for program from initial study phase through prototype production.

Newly formed project groups solve complex airborne radar problems

Engineers like the project-type organization at Raytheon's Maynard Laboratory. It gives them maximum diversification in their work on the most advanced radar navigational and control problems of the day.

At Maynard, you'll find projects involving many areas of aircraft navigation and guidance systems . . . doppler navigation, velocity check systems, night-fighter operations systems, flight-control systems, altimeters. There is also interesting new work on countermeasures equipment.

Career opportunities for men at all levels now exist in the following areas:

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Temperature Control Valve

OPW-Jordan Corp. announces that its temperature control valve incorporates Teflon impregnated asbestos stem packing in $\frac{1}{4}$ through 2 in. sizes; 125 WSP cast iron and 250 WSP bronze bodies. **—K-21**

Pneumatic Atomizing Nozzle

A new type pneumatic atomizing nozzle for simultaneous spraying in two or more directions has been announced by Spraying Systems Co.

The nozzle, said to provide a compact, simplified method to meet multiple position spraying needs in a variety of industrial applications, can be supplied with two, three, or four heads, with each adjustable to any position in a 360 degree range.

The overall nozzle unit is $1\frac{1}{4} \times 2$ in. at maximum cross-section and $4\frac{13}{32}$ in. in overall height with two swivel heads. Additional swivel heads each add $1\frac{3}{32}$ in. to the height. Nozzles are supplied standard in brass and are also available in stainless steel. **—K-22**

Blowers, Gas Pumps

A new blower, utilizing the firm's basic rotary positive principle, has been developed by Roots-Connersville Blower, Div. of Dresser Industries, Inc.

The new blower features a vertical arrangement of the impellers designed to provide horizontal inlet and discharge connections for more convenient piping. The drive shaft extends from the lower impeller to match more closely motor shaft heights. An improved segmented waist impeller shape permits safe handling of entrained liquids with more quiet operation, the company reports.

The firm says a thoroughly tested and proved flanged stub shaft design permits a higher pressure rating for a given impeller length to deliver greater displacement without extremely high rotating speeds. This design reduces overall dimensions to a minimum. External bearings and separate oil reservoir are eliminated. Delivery of completely oil free air or gas is said to be assured by double seals on the shafts—a multiple labyrinth seal plus a positive oil seal.

All units are sized for direct connection to low cost moderate and high speed motors. V-belt drives may also be used for intermediate ratings up to approximately 200 hp. Speeds are well matched to economical gas or diesel engine speeds, while steam turbine drives can be used with standard speed reducers, the company says.

Both blowers, designated Type RAS, and gas pumps, designated Type RGS, have identical volume and pressure ratings. Thirty-six sizes are offered to cover a capacity range of from 2000 to 14,000 cfm at 6 psig and from 1500 to 8000 cfm at 10 psig.

All parts of the blowers and gas pumps are identical with the exception of the gas pump bearing carrier and seal. **—K-23**

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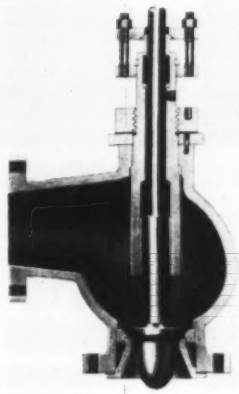
BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS



High Pressure Valves

Conoflow Corp. announces the completion of a standard line of control valves available in sizes ranging from 1 to 14 in., with pressure ratings up to 2500 lb ASA.

The S valve is a patented, single-seated, angle design, which incorporates a number of features not found in conventional control valves, the firm reports.

The valve body has streamlined contours and is of extra heavy construction throughout. A self-sealing bonnet, oversized stem and stem guide, and venturi seat ring and parabolic plug, are among the design features.

Sizes 1 through 4 in. carry ASA ratings to 2500 lb; sizes 6 and 8 in. to 1500 lb ASA; sizes 10, 12, and 14 in. to 300 lb ASA.

—K-24

Tubeaxial Blowers

A new line of small, compact tubeaxial air moving units for electronic equipment cooling is now available from American Standard, American Blower Div.

Smallest of the new air units is the Model H-84236, a $3^{1}/_{6}$-in. inside housing diameter, low-volume, high-speed fan recommended for cooling oscilloscopes or other electronic equipment. The $^{1}/_{200}$-hp unit operating at 7200 rpm delivers 75 cfm of air at free delivery (zero static pressure).

Model H-115659 which is suitable for flushing electronic equipment cubicles, racks, and cabinets, delivers 400 cfm at free delivery; motor hp is $^{1}/_{150}$ and operating speed is 1550 rpm.

—K-25

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for Quick Results

NOW AVAILABLE FROM STOCK

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WITH Duti-Rated® LIFETIME GEARING*

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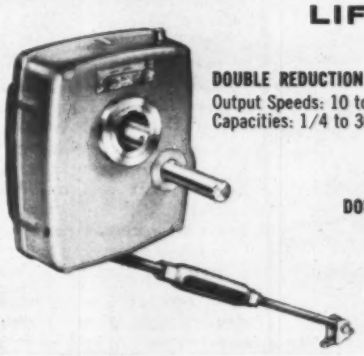
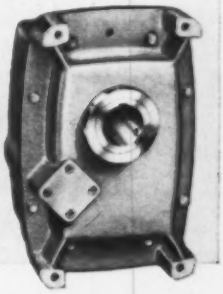
Output Speeds: 90 to 420 RPM
Capacities: 1/4 to 40 HP



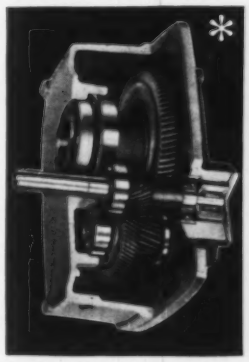
DOUBLE REDUCTION
Output Speeds: 10 to 160 RPM
Capacities: 1/4 to 30 HP

DOUBLE REDUCTION FLANGE MOUNT
Output Speeds: 10 to 135 RPM
Capacities: 1 to 7 HP



Foote Bros. Shaft Mounted Drives offer more efficient, more economical, power transmission. They incorporate exclusive Duti-Rated Lifetime Gearing — the high hardness, balanced design, premium quality gearing that combines greater load carrying capacity with long service life.

Used with standard V-Belts and Sheaves, Foote Bros. Shaft Mounted Drives will provide virtually any output speed you may require. Quick, easy installation on driven shafts with diameters from 15/16" to 3-7/16" saves time, labor . . . eliminates need for reducer mounting, couplings, and adjustable motor mount. Built-in Backstop to prevent reverse rotation, Automatic Overload Release Torque Arm, Variable Pulley, are available as optional equipment.



The complete Foote Bros. Shaft Mounted Drive line is made in accordance with all applicable AGMA Standards

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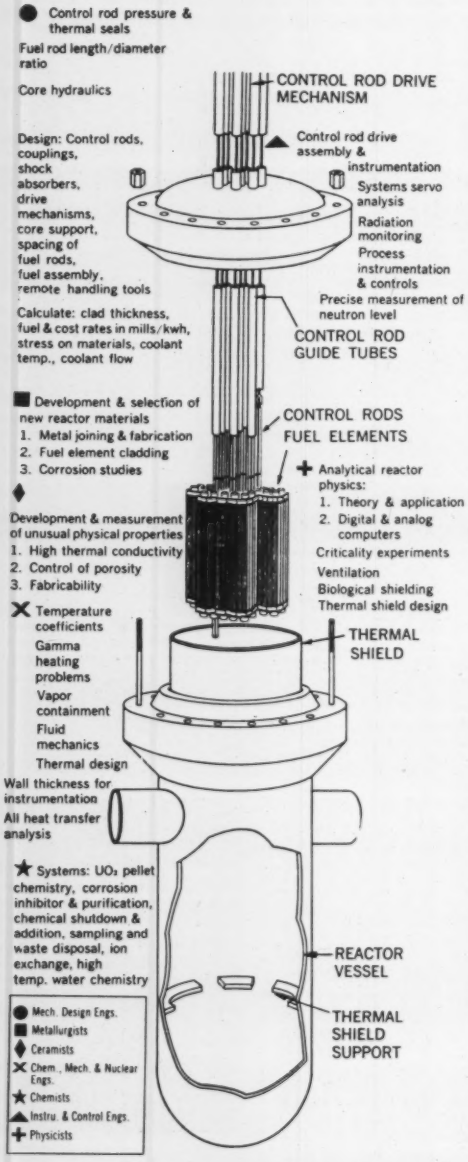
WESTINGHOUSE COMMERCIAL ATOMIC POWER COMES OF AGE

Where would you work on an atomic power reactor?


Control rod pressure & thermal seals
Fuel rod length/diameter ratio
Core hydraulics
Design: Control rods, couplings, shock absorbers, drive mechanisms, core support, spacing of fuel rods, fuel assembly, remote handling tools
Calculate: clad thickness, fuel & cost rates in mills/kwh, stress on materials, coolant temp., coolant flow
Development & selection of new reactor materials
1. Metal joining & fabrication
2. Fuel element cladding
3. Corrosion studies
Development & measurement of unusual physical properties
1. High thermal conductivity
2. Control of porosity
3. Fabricability
Temperature coefficients
Gamma heating problems
Vapor containment
Fluid mechanics
Thermal design
Wall thickness for instrumentation
All heat transfer analysis
Systems: UO2 pellet chemistry, corrosion inhibitor & purification, chemical shutdown & addition, sampling and waste disposal, ion exchange, high temp. water chemistry
Mech. Design Engs.
Metallurgists
Ceramists
Chem., Mech. & Nuclear Engs.
Chemists
Instru. & Control Engs.
Physicists
CONTROL ROD DRIVE MECHANISM
Control rod drive assembly & instrumentation
Systems servo analysis
Radiation monitoring
Process instrumentation & controls
Precise measurement of neutron level
CONTROL ROD GUIDE TUBES
CONTROL RODS
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Biological shielding
Thermal shield design
THERMAL SHIELD
REACTOR VESSEL
THERMAL SHIELD SUPPORT

This diagram shows the main parts of a pressurized water atomic power reactor, one of many types being designed at Westinghouse Atomic Power Department . . . and just what work would be done by you in the commercial atomic power industry. There are many overall studies on which you may work, as well as specific studies.

5 Commercial Atomic Power Programs Now Under Way

1. A 150-megawatt homogeneous reactor for Pennsylvania Power & Light Co.
2. The first industry-owned testing reactor for nuclear-materials study (Owned by Westinghouse).
3. A 134-megawatt reactor for Yankee Atomic Electric Co.
4. A 134-megawatt atomic plant for Edison-Volta, Italy.
5. An 11.5-megawatt pressurized water reactor for Belgium.

Also research, analysis, and development of advanced reactor types . . . and more programs, national and international, are coming in.

Immediate openings in the Pittsburgh area for: Metallurgists. Physicists. Ceramists. Mechanical Engineers. Chemists. Chemical Engineers. Nuclear Engineers. Instrumentation & Control Engineers. Atomic experience desirable but not necessary . . . we're not dependent on government subsidy . . . opportunities for advanced study on company fellowships.

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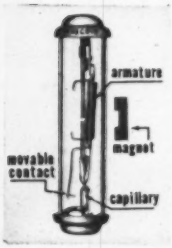


Miniaturized Magnetic Switch

A new miniaturized magnet operated capillary contact announced by Mercoid Corp., permits operation of the switch even when tilted as much as 45 deg from the vertical position.

Metallic-end caps seal the cylindrical glass envelope so that the operating parts and the mercury are maintained in a hermetically sealed enclosure.

The movable contact in the hermetically sealed switch makes contact with the mercury by penetrating an opening in the capillary tube. The capillary tube is positioned so as to be supplied by the mercury in the well.

These switches are adaptable to applications where a mechanical movement of approximately $^{32}/_{1000}$ in. (0.032") with a force of two grams is available to move the permanent magnet—such as recorders, gages, scales, etc. The switches can also be operated by small d-c electro-magnets for incorporation in electrical or electronic equipment.

Electrical connections to the switch are made through the metallic-end caps, eliminating lead wires attached directly to the switch.

Two types available: Type 6-81 normally open and Type 6-83 normally closed. Elec. Rating: (115 v a-c 0.3A, d-c 15A), (230 v a-c 0.15, d-c 0.7A), (24 v a-c 0.9A). Dimensions: Overall length $1^1/_2$ in. Outside diameter of metal caps $^3/_8$ in. Approx. weight 0.15 oz. **—K-26**

Induction Melting Furnaces

Induction melting furnaces, push-out type and tilting-type, with 50 to 5000-lb capacity for high melting speeds and accurate metallurgical control are now available from the Westinghouse Electric Corp.

For nonferrous alloys, the push-out furnace is claimed to offer advantages in transfer time and interchangeability of crucibles when no contamination from one alloy to another can be tolerated. Push-out furnaces are available as dual or single units. Tilting-type furnace is recommended for steel, ferrous alloys.

Using 30- to 1250-kw motor-generator sets, both furnaces produce uniform analyses. Their high melting speed at frequencies from 960 to 10,000 cps minimizes metal loss, and there is nothing to contaminate the molten pool, the company states. **—K-27**

KEEP INFORMED

BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Heat Exchangers

Niagara Blower Co., announces new models of its sectional aero heat exchangers in which the operation is completely protected from freezing in extreme winter climates.

Basic principle of the machine is the cooling of a liquid by the evaporation of a small amount of water on the surface of tubes through which the liquid passes. The firm states that the machines maintain temperature control within close limits by varying the amount of outdoor air flow across the coils, adjusting the capacity to the load, removing heat at the rate of input.

The new models enclose the air modulating dampers in a casing and provide for the restriction of the air supply by a manually operated damper in winter climates where the temperature remains below freezing temperatures for extended periods. Automatic modulating damper operation continues, maintaining the close temperature control. Heat supply for warm up periods or between shut-downs is available from an outside source.

These features are available on sectional models in which the cooling coils are supported by the spray pan and the main foundation. The entire casing consists of removable panels giving complete access to all internal parts. Unit water cooling capacities in these machines range up to 18 million Btu per hour. —K–28

Glass Fittings

Eight new types of corrosive-resistant glass drainline fittings have been added to the Pyrex brand Double-Tough line of pipe produced by Corning Glass Wks.

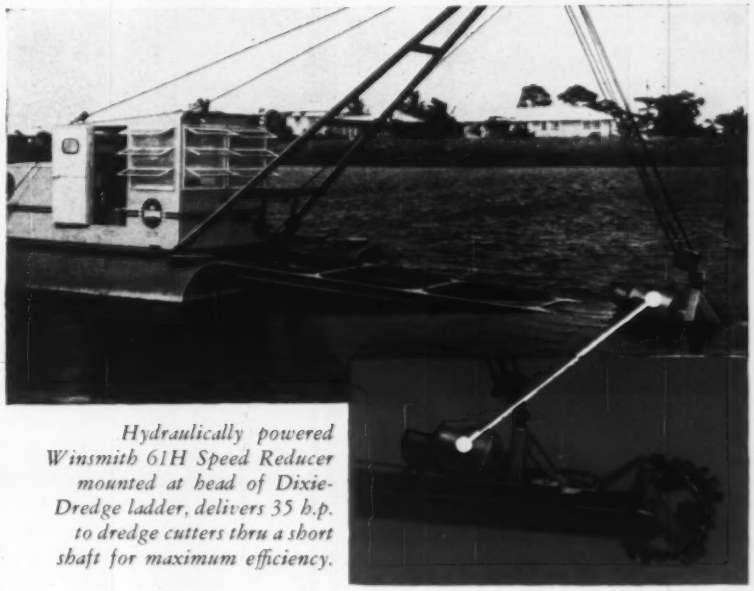
Sizes range from $1\frac{1}{2}$ to 6 in. in diameter. The fittings, now available from stock, include T-branches and reducers, T double branches and reducers, combination Y and $\frac{1}{8}$ bends and reducers, double branch combination Y and $\frac{1}{8}$ bends and reducers, Y double branches and reducers, double quarter bends, upright Y or H fittings and reducers, also used as vent branches, and offsets.

The fittings are made of tempered, high-strength borosilicate glass. Joints require no packing; this eliminates the principal failure point in ordinary drainline systems, the company states. Positive compression at the joints provides a permanent seal.

The glass is resistant to more corrosives than any other material used for drainlines, the company points out. It is affected only by hydrofluoric acid and hot alkalis. The heat-resistant glass can handle temperatures up to 450 F and records the lowest thermal expansion rate of any drainline material. With expansion of only .22 in. per 100 ft per 100 deg F change, the fittings have good heat-shock resistance. This permits cleaning with low pressure steam, the firm says. —K–29

Winsmith speed reducers used by Dixie-Dredge

in "one of the toughest jobs ever applied!"



Hydraulically powered Winsmith 61H Speed Reducer mounted at head of Dixie-Dredge ladder, delivers 35 h.p. to dredge cutters thru a short shaft for maximum efficiency.

"Winsmith Speed Reducers driving Dixie-Dredge cutters have a high shock load application and probably perform one of the toughest jobs ever applied," reports John H. Milne, president of Service Machinery Corp., North Miami, Florida, makers of this highly efficient, self-contained mobile dredging unit.

"Winsmith Reducers offer us a high torque output in a small package," says Mr. Milne. *"It operates at all angles from vertical to horizontal and has been very satisfactory in use."*

If you want satisfaction such as Service Machinery and leaders in every other industry are enjoying, check these Winsmith advantages: (1) most complete selection for every output requirement from 1/100 h.p. to 85 h.p. in ratios from 1.1:1 through 50,000:1, (2) shaft and mounting arrangements to fit your installation, (3) maximum torque designed into minimum space, (4) sound engineering and craftsmanship backed by over fifty years in the business. Write today for Catalogs 155 and SM-57. Select the "custom" reducer for your job from Winsmith Standard stock!

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BUSINESS NOTES
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Rotary Air Motor

A new rotary air motor, designed for operations which require up to 1/8 hp built into a limited space and those which require light weight for portability has been announced by Gardner-Denver Co.

The unit, called the Keller 71A-1 series, is 7 1/8 in. long, and 1 3/4 in. in diameter at the mounting lugs. Developing 1/8 hp and up to 36 in.-lb of stall torque, it is available in three basic speeds: 20,000, 5000 or 1000 rpm. An adjustable plug-type regulating valve permits changing speed and torque in any of the three basic units.

The motor and gearing are designed for lubrication with a fine mist of oil provided by an air line lubricator. Muffling installed on the front of the spindle case to keep noise level to a minimum, the firm reports.

—K-30

Lightweight Jackhamer

A lightweight rock drill, called the J-30A Jackhamer, has been introduced by Ingersoll-Rand for applications in construction, maintenance and mining work.

The blower valve is incorporated into the throttle valve in the new drill. The firm says that, by merely turning the throttle valve to its rearmost position, the operator directs air under full line pressure through the drill rod and bit to clean instantly the hole of all cuttings.

The unit's multiple-use backhead design is said to permit easy conversion from the standard blower style drill to the plain dry or wet styles. —K-31

Magnetic Pulleys

A new line of small diameter nonelectric magnetic pulleys, designed for lower cost applications in materials handling and light duty separation, has been announced by Dings Magnetic Separator Co.

The new 4-in. diam Alnico pulleys are available in two types to cover a wide range of applications. The peripheral type is used to convey, turn, lift, transfer, and hold such ferrous materials as sheets, tubes, bars, rods, and other parts. The magnetic field is continuous around periphery of the pulley, to assure steady and continuous movement of parts.

Transverse pole type pulleys are said by the company to be most effective when installed as a conveyor head pulley for self-cleaning magnetic separation on such bulk material as chemicals, foods, grain. In separation work, the diameter pulleys handle burdens up to 1 or 1 1/2 in. deep, depending upon type of burden, type of tramp iron, and belt speed.

Both the peripheral type and the transverse pole type pulleys are automatic in operation and no manual handling is required. The pulleys are constructed of aluminum with exposed steel pole pieces. Both types are available in eleven face widths, ranging from 5 to 25 in., in standard 4 in. diam. —K-32

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Commercial Fittings

Low priced fittings have been added to the Double Diamond line of products produced at W-S Fittings Wks., Forge and Fittings Div., H. K. Porter Co.

They are named commercial fittings to differentiate them from regular code fittings, and include hex bushings, caps, and plugs. The fittings will adhere to a consistent guaranteed analysis, the company reports. They will be packed 100 to a carton, labeled gray for identification. —K-33

Flexible Couplings

A line of flexible couplings in sizes to 4250 hp, said to feature quick installation and easy alignment, is announced by Lovejoy Flexible Coupling Co.

Bore sizes range to 9½ in. Bodies and jaws are machined electric steel or nodular cast iron. No complicated mechanisms or intricate parts are used, the firm states, and the load is entirely transmitted through compression of individual load cushions. This is designed to eliminate wear on the metal jaws and permit reversals or advancing of cushions on nonreversing loads to double cushion life. —K-34

End Suction Pumps

Nagle Pumps, Inc., has announced a new line of pumps, designated the K series.

They are designed for abusive applications exclusively, such as these involving abrasion, corrosion, or handling of hot liquids. The firm says they are especially desirable for the latter, because of the exposed shaft design. Pumps can be stationed either above or below sump liquid level.

The units are single state, end suction pumps, made in sizes from 1 to 10 in., for heads, in some cases, up to 250 ft on more and for capacities in the range of 4000 gpm.

They are available in three basic design. Type KR for limited heads has end plate secured to housing by easily removable dogs. Type KC for corrosive or mildly abrasive applications, where frequent inspection is unnecessary, has a center split casing, the two halves being bolted together. Type KF for high pressure abrasive or corrosive applications, has end plate secured to the housing by means of flanges and bolts.

All three types are available with simple slippage seal adjustment in bearing stand. Housings or water ends are available in a variety of metals or alloys. —K-35

ALWAYS NEEDED

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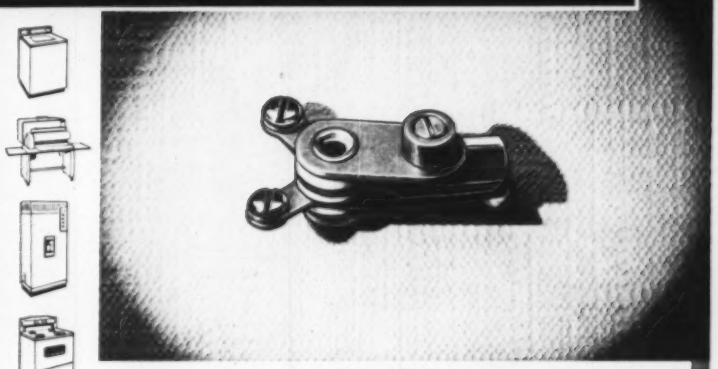
CHACE

THERMOSTATIC BIMETAL

ACTUATES ANOTHER PRECISION PRODUCT



A PRODUCT OF NORWALK THERMOSTAT COMPANY, NORWALK, OHIO

THE NorStat THERMOSTAT

NorStat Type A Thermostats (non-adjustable shown) provide make and break control of electrical circuits in appliances, heating and ventilating equipment, business machines, vending devices, manufacturing machinery and accessories. Which makes it quite likely you've unwittingly depended upon this hidden control in a percolator, beverage vendor, solder pot, furnace, sterilizer — or scores of other temperature actuated devices. The operating range is from 0° F. to 650° F. Accuracy is assured by NorStat's lubricated adjusting system insulator which rides on a raised dimple in the lower spring blade — and, of course, by the reliable actuating element of Chace Thermostatic Bimetal.

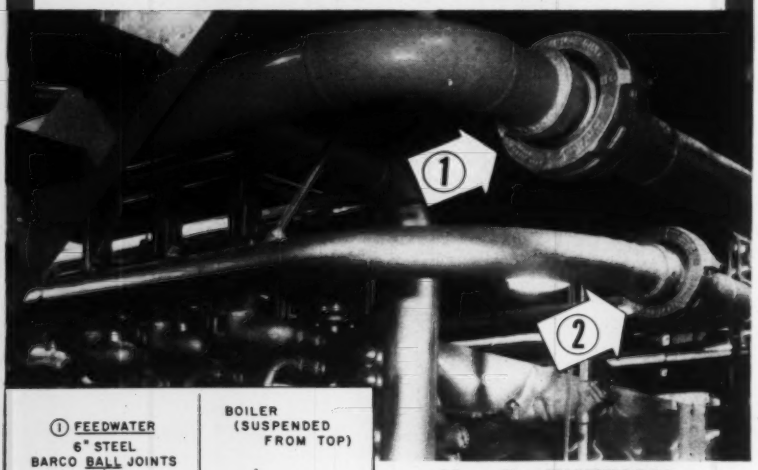
In order to produce a large volume of sensitive controls such as the NorStat Thermostat and *know* that the devices will continue to function without attention, the manufacturer must select his source of bimetal with care. He must be assured that the actuating element is of the alloys most suitable for his purpose, that tolerances are maintained always, that manufacturing processes and equipment are such as produce top quality, that the price is fair — quality considered — and that the integrity of the source is beyond question. Our more than a third of a century devoted exclusively to the development and production of precision thermostatic bimetal is his assurance of our qualifications to satisfy the most demanding.

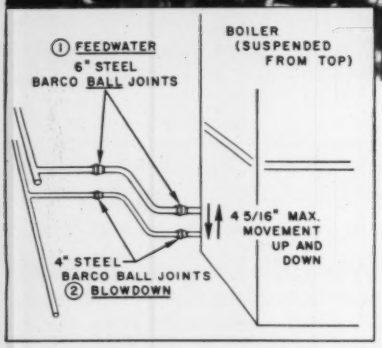
So remember Chace when you, too, design for protection of life, valuable equipment, or for temperature actuation or indication. Dependable Chace Thermostatic Bimetal is available in over 30 types, in strip, coil or completely fabricated and assembled elements to your design. Send for our new 1958 booklet, "Successful Applications for Chace Thermostatic Bimetal," containing many pages of design data.

IT BENDS WITH THE HEAT

W. M. CHACE CO.
Thermostatic Bimetal
1619 BEARD AVE., DETROIT 9, MICH.

. . . where BOILERS move UP and DOWN





Handle THERMAL EXPANSION with BARCO Ball Joints

The schematic diagram at left shows how Barco Flexible Ball Joints of steel construction are used in a new Florida utility plant—design pressure 600 psi, 500°F. The above photo shows a close-up view of two of the joints (see arrows). Two more matching joints, 4" and 6", are located out of the picture to the left. The 4" joints have metal gaskets. The same utility also uses 10" Barco joints on gas fuel lines. Other uses in power plants are for flexible connecting lines to oil burners, soot blowers, and other auxiliary equipment.

Flexible Pipe Connections!

The rapidly increasing use of Barco Flexible Ball Joints for solving piping problems in POWER PLANTS is significant for several key reasons:

1. Substantial space saving as compared to other methods in crowded piping areas.
2. Unlimited flexibility and movement. Utmost simplicity.
3. No heavy pipe anchoring required. No "end thrust" developed under pressure.
4. Ability to handle compound movement (where twisting is combined with thermal expansion and contraction).
5. Easy to engineer joints into piping to provide for any degree of flexibility, expansion, or movement required.
6. Maximum safety for high temperature applications. All-metal construction available. Special alloys can be specified.
7. Basic design is pressure sealing against leakage and self-adjusting for wear.
8. Virtually no deterioration. Able to stay in service for years without repairs or maintenance. No lubrication.

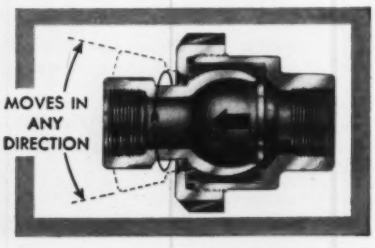
New Bulletin No. 31 contains interesting diagrams showing how to solve many common pipe expansion problems EASILY, ECONOMICALLY. *Ask for a copy;* see your nearest Barco representative or write:

PRODUCTS BACKED BY EXPERIENCE
BARCO
ANNIVERSARY
— 60TH —

BARCO MANUFACTURING CO.
5211 Hough Street, Barrington, Illinois

The Only Truly Complete Line of Flexible Ball, Swivel, Swing and Rotary Joints

In Canada: The Holden Co., Ltd., Montreal



KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Conveyor Belt Guide

Mechanical Goods Div., U. S. Rubber Co., has issued a conveyor belt trouble-shooter, a pocket-sized device designed as a quick method for locating the probable causes of conveyor troubles, and listing specific cures. **—K-36**

Air Vent Valves

Aero Supply Mfg. Co. announces air actuated vent valves designed to permit the free flow of air in both directions when the fuel level sensing device is exposed to air.

The firm explains that when the fuel level sensing device is submerged in fuel, the valve is closed, but will reopen to relieve tank pressure exceeding a desired value. The fuel level sensing device is a patented element replacing conventional floats and actuating mechanisms. It is not affected by altitudes and will perform in a full circle.

Temperature range is −65 to +350 F, and the unit can be adapted for higher temperatures, the company says. The valve will work with all aircraft fuels and is designed to eliminate the problem of acceleration and mechanical failures due to vibration and slosh.

Its dimensions for a $1^1/_2$ in. line is 6.50 in. long, 5.0 in. high and 3.75 in. wide; weight is 2.2 lb. **—K-37**

BUSINESS NOTES

Cement Pipe Plant

Johns-Manville has opened the first continuous-process asbestos-cement pipe plant in the United States at Denison, Tex.

The plant is situated on a 469-acre site on the banks of the Red River which separates Texas from Oklahoma. It adjoins the man-made Lake Texoma, ninth largest water reservoir in the world. The plant is one of eight new Johns-Manville factories being brought into production in the United States and Canada during 1958.

Reinforced Teflon Parts

Facilities for the design, compounding, and molding of packings, gaskets, bearings, square rings, and other component parts of reinforced Teflon tetrafluoroethylene resin are now in operation at the special elastomers plant of Chicago Rawhide Mfg. Co.

According to the company, the chemical, thermal, and mechanical properties of Teflon may be distinctly improved by the use of reinforcing inorganic additives.

Need more engineering information on products featured in this issue?

USE THE POSTAGE-FREE CARDS

If you would enjoy receiving additional engineering information on any of the products

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detailed in the Keep Informed Section

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6, 7	25	37	141	155	168	176	190B	
8, 9	26	38	143	157	169R	177	191BL	
10, 11	27	39, 40	145	159	170	179	191R	
12	30	41	146	160	171T	181	192	
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K-2	K-13	K-24	K-35	K-46	K-57	K-68	K-79
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K-4	K-15	K-26	K-37	K-48	K-59	K-70	K-81
K-5	K-16	K-27	K-38	K-49	K-60	K-71	K-82
K-6	K-17	K-28	K-39	K-50	K-61	K-72	K-83
K-7	K-18	K-29	K-40	K-51	K-62	K-73	K-84
K-8	K-19	K-30	K-41	K-52	K-63	K-74	K-85
K-9	K-20	K-31	K-42	K-53	K-64	K-75	K-86
K-10	K-21	K-32	K-43	K-54	K-65	K-76	
K-11	K-22	K-33	K-44	K-55	K-66	K-77	

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Opens Texas Plant

Ladish Co. has announced the opening of a new manufacturing plant, sales service office, and warehousing facilities which will operate as Ladish Co. Texas Div.

The plant, located in Houston at 1301 West Belt Dr. N. will serve industries in Texas, the Gulf Coast area, Mid-Continent, and the Southwest with service in pipe fittings, corrosion resistant valves, saw blades drop forgings, and rolled rings.

Chemical Processing

A new Chemical Process Department, formed within the company to handle its expanding program of liquid treatment applications, has been announced by the Graver Water Conditioning Co.

The new department will be responsible for the application of unit process operations to the processing, purification, separation, or recovery of products used and produced by a variety of industries. These unit operations include ion exchange, sedimentation, filtration and flotation. They will be provided by Graver to achieve such results as product stabilization, decolorization, deacidification, recausticizing, deashing, the firm reports.

LATEST CATALOGS

Automatic Clutches

Mercury Clutch Div., Automatic Steel Products, Inc., announces a bulletin illustrating and describing its automatic mercury and automatic mechanical clutches.

Capacity ranges, application, and selection recommendations, and cutaway illustrations showing construction details are included in the pamphlet. —K–38

Metal Shapes

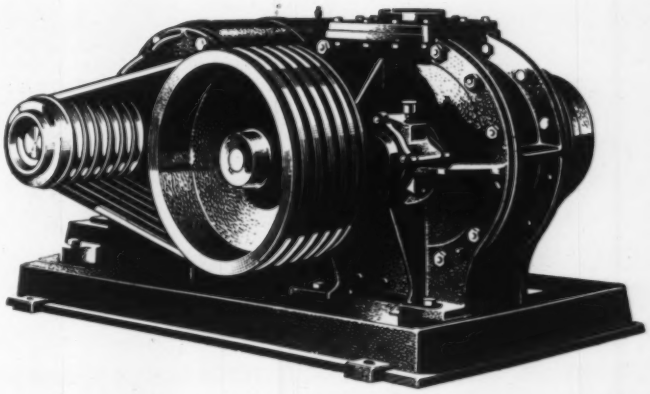
Van Huffel Tube Corp., announces a 48-page handbook covering roller die, cold formed metal shapes.

The book gives information on material selection, roller dies and forming mills, processing, general specifications, machine operations, typical section profiles, fabrications and assembly of shapes. —K–39

Standard Gears

Cone-Drive Gears Div., Michigan Tool Co., has issued Bulletin CD-173, covering its line of standard gears.

Application photos and information is given on the use of the gears in aircraft, agriculture, bakery, chemical, conveyor, construction, foundry, machine tool, mining, paper and printing, steel industries. —K–40



R-C gas pumps eliminate friction and leakage problems

One of the many operating advantages of Roots-Connersville rotary positive displacement gas pumps are the exceedingly small losses due to leakage and friction. This high efficiency is assured by the inherent design of the pump in which the impellers operate without internal contact. Yet so accurately gauged are the clearances that slippage is reduced to an absolute minimum. Maximum power savings are realized since horsepower required is determined by operating pressure.

From 5 to 50,000 cfm, these pumps assure positive control of both volume and pressure. Design simplicity further assures long term peak performance with little down-time and maintenance held to a minimum.

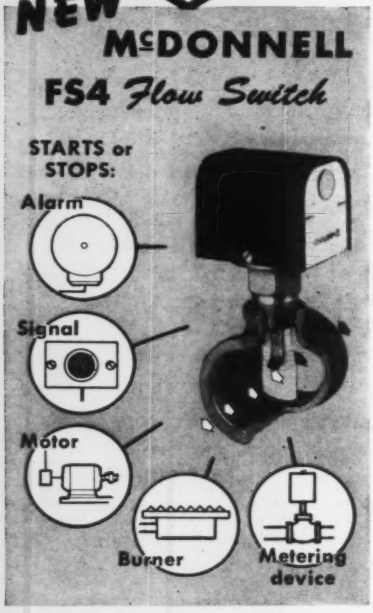
Available in 76 capacities and sizes, R-C rotary gas pumps can be exactly matched to your requirements. For engineering data, write for Bulletin 32-33-B-13 or Bulletin 31-B-17 on small pumps.

Engineers—unusual career opportunities await you at Roots-Connersville. Address your resume to Professional Employment Manager.

ROOTS-CONNERSVILLE BLOWER
A DIVISION OF DRESSER INDUSTRIES, INC.
858 Michigan Avenue, Connersville, Indiana. In Canada – 629 Adelaide St., W., Toronto, Ont.

Makes or breaks a circuit when flow starts ...or stops

NEW McDONNELL FS4 Flow Switch



The illustration tells the story of the McDonnell FS4 Flow Switch. Installed in a pipe line, it is a moderately priced, highly dependable device that makes or breaks a circuit when flowing liquid moves the paddle—to perform almost endless functions vital to safety and automatic operation. Underwriters' Listed.

New Bulletin FS-1 fully covers all details of construction and service ranges. Also contains typical applications that may suggest important services the FS4 Flow Switch can perform in your plant.

McDONNELL & MILLER, *Inc.*
3510 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well

McDONNELL *Flow Switches*

Boiler Water Feeders • Low Water Fuel Cut-Offs • Pump Controllers • Relief Valves • Related Liquid Controls for Tanks, Stills, Air Conditioning Systems

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BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Speed Reducers

A booklet on shaft-mounted speed reducers is available from Westinghouse Electric Corp.

The 10-page engineering manual discusses selection, horsepower ratings, dimensions, construction, installation, and maintenance for the new Moduline shaft-mounted speed-reducing units. Illustrated with photographs and cutaway views, the booklet describes how to select shaft-mounted reducers considering AGMA service factors for particular applications. **—K–41**

Multiport Relief Valves

Bulletin 5200-A describing features of multiple disk relief valves for steam systems is announced by Cochrane Corp.

Specifications for vertical, horizontal, and angle styles in sizes from 4–48 in., 0–25 to 0–100 psig pressure, are given. Installation diagrams and data on selecting and specifying are included in the booklet. **—K–42**

Receiver Recorder

A 16-page product specification, E12-5, containing details of newly developed plug-in components for its recorder is announced by Bailey Meter Co.

Twelve types of receivers, controllers, retransmitters, and direct measuring devices from which the recorder may be custom-built are described. Also illustrated is sealed, automatic one-year inking system, and exclusive features of the unit. **—K–43**

Hydraulic Tube Fittings

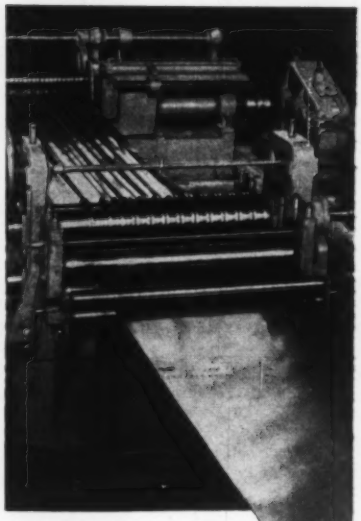
A 28-page catalog covering its line of hydraulic tube fittings has been published by Flodar Corp., it has just been announced.

The catalog is divided into sections covering self-flaring fittings, no-flare fittings, and flare-type fittings. Each section contains information on the design and installation of the particular type covered plus dimensional and engineering specifications. Information on all popular shapes and sizes from $^1/_8$ to 2 in. is included. **—K–44**

Flexible Coupling

Bulletin No. 10100A, issued by T. B. Wood's Sons Co., has been revised to cover new additions to its line of Sure-Flex couplings, which now includes ten sizes.

The additions are: No. 3 ($^3/_8$ to $^3/_4$ in. bore) No. 4 ($^1/_2$ to 1 in. bore), No. 11 ($1^7/_8$ to $2^3/_8$ in. bore) and No. 12 ($2^3/_8$ to $2^7/_8$ in. bore). Selection data and other engineering tables have been revised to include these large and small coupling sizes. The revised tables also include newly designed couplings with ductile-iron flanges and a special steel retaining ring and specially balanced couplings. Both new types are available in sizes from No. 5 through 12. **—K–45**



Greater Profit and Operational Flexibility with a YODER SLITTER

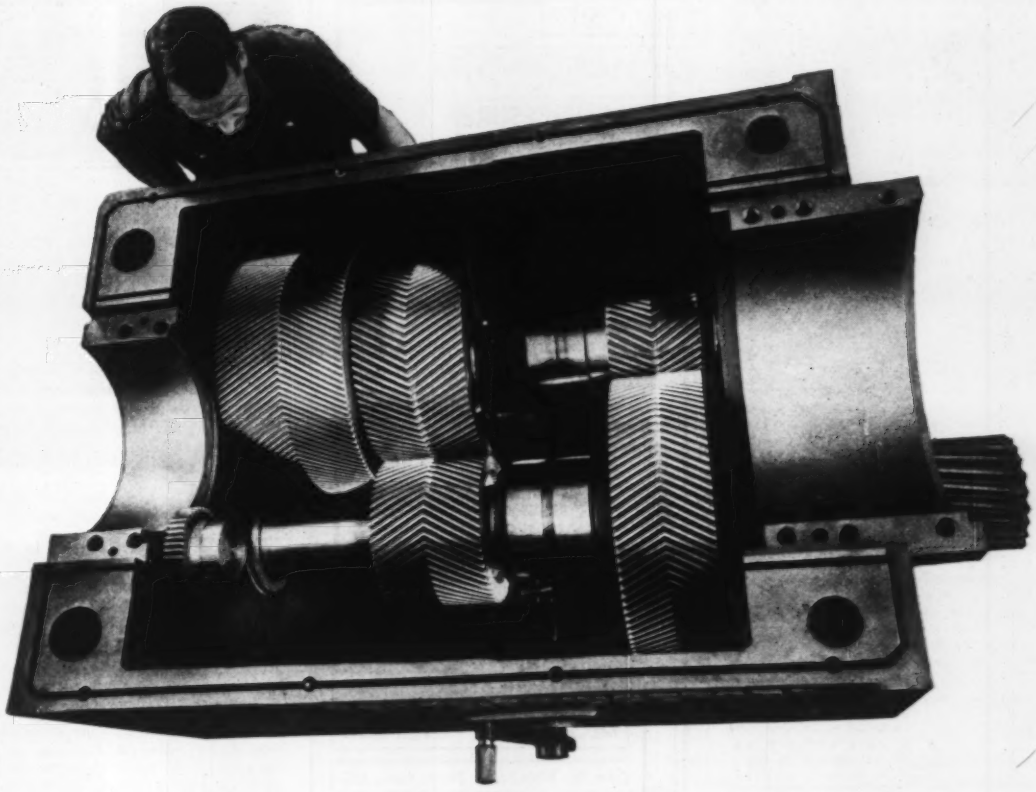
Even if you use less than 100 tons of varied strip sizes per month, it will pay you to investigate the savings that are possible through the operation of a Yoder slitter. Savings per ton increase rapidly as coil size and width of strands decrease...so much, that under average operating conditions, a slitter will pay for itself in a few months.

From a small stock of standard mill-width coils, a Yoder slitting line enables you to meet unexpected demands, or to supply "special" width slit strands in a matter of a few hours. This flexible operation increases plant efficiency, resulting in savings of time and money through simplified production planning and greatly reduced strip inventories.

The Yoder line includes slitters of every size and capacity for coil or sheet stock. Send for the all-new, 1958 edition of the Yoder Slitter Book. It is a comprehensive text on the mechanics and economics of slitter operations with time studies, cost analyses, and other valuable data. Write to:

THE YODER COMPANY
5499 Walworth Avenue • Cleveland 2, Ohio

YODER ROTARY SLITTING LINES



You can tell at a glance

THESE ARE PRECISION GEARS

Aside from the obviously fine finish of the gears in the large lathe headstock above, there's another sure clue to their precision—the teeth are continuous across the face. That is a characteristic of herringbone gears made on a Farrel-Sykes generator, although the gears can be made with a center groove when required.

The accuracy inherent in the operating principle of the Farrel-Sykes gear generating machine assures accurate tooth spacing, profile and helix angle. Thus, you can be sure that Farrel® herringbone gears will operate smoothly, quietly and efficiently over a long service life.

When you specify Farrel gears in your designs, you get the kind of accuracy needed for today's machines and machine tools. We shall be glad to discuss your requirements and supply further information.

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ANSONIA, CONNECTICUT

Plants: Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.
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FB-1139

Farrel-Birmingham®

Farrel® gears are made in all types that operate on parallel axes.

OPW-JORDAN
pressure reducing
VALVE

with the Sliding Gate and Plate

the heart of the OPW-JORDAN Valve

No. 160

THE DIFFERENT AND IMPROVED WAY TO PRECISE PRESSURE REGULATION

- DEAD END SHUT-OFF
- WIRE DRAWING MINIMIZED—or eliminated
- SELF-LAPPING SEAT
- NO HUNTING—SHORT STROKE FOR IMMEDIATE RESPONSE

*Daily replacing troublesome pilot operated valves.

For details write for Bulletin J-160

JORDAN CORPORATION
INDUSTRIAL SALES DIVISION OF OPW CORPORATION
6013 WIEHE ROAD
CINCINNATI 13, OHIO
ELmhurst 1-1352

VISCOSITY
OF LUBRICANTS
UNDER PRESSURE

This Report reviews twelve experimental investigations made in England, Germany, Japan, Russia, and the United States on 148 lubricants comprising 25 fatty oils, 94 petroleum oils, 17 compounded oils, and 12 other lubricants. Data collected are co-ordinated by means of sixty tables in which the results originally appearing in diversified units are compared. The methods proposed for correlating viscosity-pressure characteristics of oils with properties determined at atmospheric pressures are reviewed and illustrated. Pertinent topics such as experimental work on heavily loaded bearings, lubrication calculations, and additional techniques for viscosity are covered. Conclusions and recommendations are presented. Other sections give the required computation of temperature and pressure coefficients, a bibliography of 189 items, and symbols.

1954 $5.00

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MECHANICAL ENGINEERS
29 W. 39th St. New York, 18.

The 1959 MECHANICAL CATALOG will be available September 30, 1958

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OVER 6000 ENGINEERED PRODUCTS—EQUIPMENT, PARTS AND MATERIALS!

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OVER 300 PAGES OF MANUFACTURER'S PRODUCT CATALOGS AND SPECIFICATIONS!

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20 PAGE CATALOG OF ASME PUBLICATIONS!

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BUSINESS NOTES · NEW EQUIPMENT · LATEST CATALOGS

Interfloor Conveying

An interfloor conveying system which transfers stereotype plates from stereo department to pressroom, 90 ft, in less than 2 minutes in a newspaper plant is described and illustrated in a four-page technical report—offered by Gifford-Wood Co.

Six photographs and a schematic drawing show how the system transports and returns the stereotype plates between the casting department and the pressroom by means of reversal switches. —K–46

Light-Wall Tubing

Thinweld tubing, produced in sizes from $\frac{1}{2}$ to 9 in. in diameter with wall thicknesses from .002 to .049 in. maximum, and from more than 80 metals, is illustrated and described in Bulletin No. 60 published by Western Pneumatic Tube Co.

The 12-page booklet says the tubing wall thickness does not exceed one per cent of the outside diameter. The wall-to-diameter ratio may be obtained in the as-welded condition or by subsequent sizing or drawing operations. A table lists 84 metals and alloys used in the production of the tubing. These materials are classified as stainless steels; super alloys and high-temperature materials; iron, copper, and nickel base alloys, and reactive metals. —K–47

Metal-Ceramics

New metal-ceramics, said to show definite promise in the area of high-temperature service where most metals or ceramics alone can't do the job, are covered in a booklet released by Haynes Stellite Co.

Typical parts made of metal-ceramics are rocket nozzle inserts, jet flame holders, thermocouple protection tubes, mechanical pump seals, furnace muffles, flame guardian rods, molten metal control pins and spouts, and other parts for special service. These sections are made by slip casting, and are readily machined or ground, the firm says. The 12-page booklet contains physical, mechanical, and chemical properties, and typical applications of these new cermets. —K–48

Valve Laboratories

The world's largest research and experimental laboratories devoted exclusively to steel valves are described in a new four-color 32-page booklet now available from Edward Valves, Inc., subsidiary of Rockwell Mfg. Co.

The booklet shows how valve research is carried on through flow studies, stress analysis, accelerated temperature tests, radiographic and other inspections, nuclear flow loop tests, aging procedures, packing studies, foundry investigations, and basic metallography. —K–49

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Bellows Flow Meter

Specification S292-2, describing the construction and operation of its bellows meter for flow and liquid level applications, is announced by Minneapolis Honeywell Regulator Co. Included are features, specifications and options of the units. —K–50

Pneumatic Instruments

United States Gauge, Div. of American Machine and Metals, Inc., has issued Catalog 510 on pneumatic instruments for process control.

Illustrated and described are pilot controllers, transmitters, receivers, recording controllers. Dimension diagrams and tables, specifications and cutaway photos of the various units are included in the booklet. —K–51

Gas Engines

A series of three new fliers published by Ingersoll-Rand describes a line of 4-cycle, V-angle gas engines for industry.

Three models of these gas engines are built, the company reports. They are PJVG, with a range of 220–295 hp; PSVG with a range of 408–816 hp; and PKVG with a range of 880–1760 hp range. The machines are said to be rugged and compact and are built for dependable continuous service at partial or full loads and speeds. —K–52

Bin Level Indicators

A consolidated catalog is available for all three units made by Bin-Dicator Co. for all bulk material, level indication, and control.

The catalog includes photographs, cutaway, and schematic drawings, outline dimensions, general specifications, special bin and conveyor applications, actual and suggested systems, and applications for diaphragm type bin level indicator, rotating paddle type bin level indicator, and aerator, to promote flow of dry, finely ground bulk materials. —K–53

Cocks, Valves, Gages

Roberts Brass Mfg. Co., has issued Catalog 561, illustrating and describing its line of cocks, valves, and gages.

Included is information on gas filters, hose nipples, water gages, and cocks for air and steam compression gages, hose, shut-off, and steam gages. Valves for various appliances are shown. —K–54

Pneumatic Products

A 20-page catalog featuring air line filters, regulators and lubricators is announced by Watts Regulator Co., Industrial Div.

Engineering and operational data, including performance characteristics, quick sizing charts, and specifications are included. —K–55

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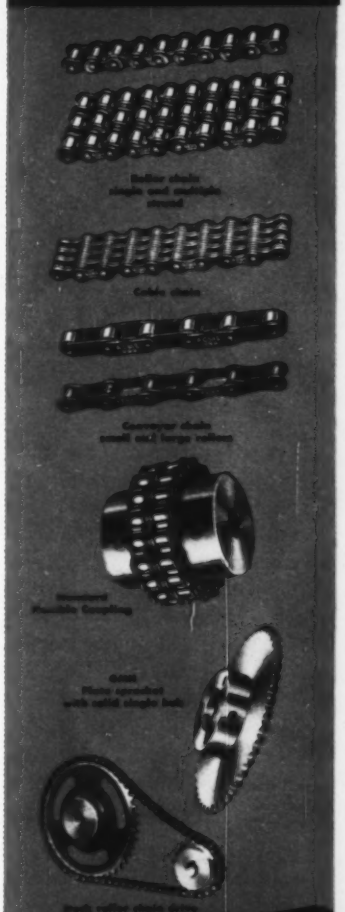

Write Dept. 11-R for new illustrated 100 page catalog which includes new engineering section showing 36 methods of chain driving.

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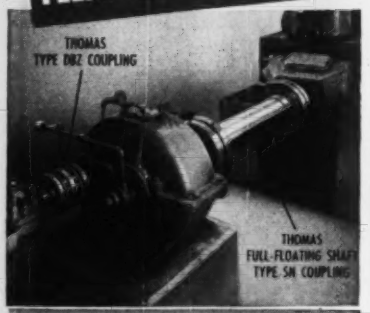

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Flexible Ball Joints

A four-page catalog on flexible ball joints for handling liquid oxygen and high energy fuels has been published by Aircraft Div., Barco Mfg. Co.

The catalog includes specifying information on Type FL stainless steel flexible ball joints which are expecially designed for installation in metal fueling lines on ballistic missile launchers and ground support equipment. These joints provide for either swiveling or angular flexing movement and for thermal contraction in piping. —K–56

Titanium Arc Welding

A technical brochure discussing the method and techniques used in arc welding titanium has been published by Mallory-Sharon Metals Corp.

The brochure lists the various commercially pure titanium grades and titanium alloys which can be arc welded. Basic problems in handling these materials are discussed. Preferred joint designs, edge and surface preparation, welding conditions and equipment necessary to do the job are detailed. A table shows maximum bends available. Typical baffle arrangements are also presented, as well as inspection and test techniques. —K–57

Malfunction Detector

An industrial bulletin released by the Aeronautical and Instrument Div., Robertshaw-Fulton Controls Co., explains and illustrates the functions of Model 65 Vibraswitch malfunction detector.

Operating principles, installation diagrams, dimensions and adjustment considerations are included in the four-page bulletin, RF-586. The unit is said to provide protection for large motors, pumps, compressors and other rotating equipment by responding to mechanical malfunctions the instant they occur. —K–58

Float Controls

H. A. Phillips & Co. has issued a bulletin illustrating and describing its line of float controls for air conditioning and refrigeration applications.

The booklet contains capacity tables, diagrams of various applications, and specifications and dimensions for valves for use with ammonia and Freon. —K–59

Stationary Compressors

Joy Mfg. Co. has published a bulletin on heavy-duty high pressure stationary compressors.

The eight-page bulletin includes specifications on four basic high pressure models which range in capacity from 368 to 2000 cfm. Installation photos, sectional drawings and charts are given for the compressors which are designed for soot blowing, chemical processing and gas compression. —K–60

Sliding Gate Valve

A two-page bulletin, J-90, describes OPW-Jordan sliding gate sampling valves, designed for drawing off fluid samples for examination or laboratory test. The bulletin describes such features as self-cleaning seating construction, self-closure, and no packing. The valves are available in bronze, cast iron, monel or aluminum bodies with stainless steel trim in $^1/_4$ and $^3/_8$ in. sizes, with pressure ratings to 200 psi. —K–61

Roll Grinders

A bulletin, No. 120, covering heavy-duty roll grinders is available from Farrel-Birmingham Co.

In its 28 pages are photographic illustrations and cross-section drawings of important features of the machine, including a number of recent design innovations. The bulletin also contains tables of general specifications and dimensions and weights for all six sizes available. —K–62

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Filter Manual

A 132-page, two-color filter engineering and application reference manual is announced by Bendix Filter Div., Bendix Aviation Corp.

The new manual covers filters for aircraft, missiles, industrial and ground support equipment. Filters for lubricating oils, gasoline, jet fuels, hydraulic fluids, compressed air, gases, de-icing fluids, air conditioning systems, test stands, and refueling installations are described and illustrated in detail. —K-63

Plastic Products

Raybestos-Manhattan, Inc. has issued a 32-page catalog covering its line of products made from Teflon, Raylon and Kel-F.

It gives information on the properties of Teflon, and describes and provides specifications for sheets, rods, tubes, and tapes made of it and Raylon, the firm's name for its mechanical grade of Teflon. Data and illustrations are also provided on mechanical packings, gaskets, expansion joints and flexible couplings, custom-machined parts, wire braid and rubber covered hose, tubing, O-rings, bearings, and coatings. —K-64

Variable Voltage Transformers

M & T Corp., has released a four-page bulletin describing the design and construction characteristics of its heavy-duty variable voltage transformers in the 5 to 41.5 kva range.

The bulletin contains illustrations, exploded views, and schematic diagrams of both single and three phase variable-voltage transformers. Brief specifications are also included. —K-65

Centrifugal Pumps

Ladish Co., Tri-Clover Div., offers a bulletin describing its series of industrial stainless steel pumps.

Heavy-duty units have new design features for pumping of corrosive materials in process industries. These include volute type pump head, Francis type impeller, spacer type coupling. Specifications include dimensions, description of four different seal type arrangements, plus separate sheets covering pump capacity curves. —K-66

Flexible Gear Couplings

An enlarged catalog on flexible gear couplings has been published by Sier-Bath Gear and Pump Co., Flexible Coupling Div.

The new C-5 reference manual details the range of standard types and sizes, as well as information on available special types of couplings. In addition, there are sections on cost-cutting advantages of the product; installation information; typical applications; lubrication requirements and engineering data. —K-67

Chimney Designing IS A SPECIALIZED SERVICE

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Ovens, Dryers, Heaters

J. O. Ross Engineering Div., Midland-Ross Corp., offers an eight-page booklet pertaining to ovens, dryers, and heaters used in paper drying and conditioning; pulp and paper mill ventilating, heating and cooling; paint finishing; textile drying and conditioning; hot blast cupola operation; fume incineration.

The booklet illustrates applications of equipment in baking cores, drying linings of cans, finishing automotive parts, preparing metal for painting, curing plastics, drying paper. —K-68

Expansion Joints

Badger Mfg. Co., announces the availability of an 80-page catalog covering its S-R expansion joints.

The publication includes information for rating expansion joints subjected to axial or lateral movement, angular rotation or combinations of these movements, together with formulas and tables for calculating the forces and/or bending movements developed in the connected piping or equipment. —K-69

Pump-Motor Unit

A new pump-motor unit for original equipment requiring circulation of corrosives and for pilot plant and laboratory uses is described in Bulletin 624A4 issued by Goulds Pumps, Inc.

The pump is designed for heavy-duty continuous operation with capacities to 16 gpm and heads to 28 ft at temperatures to 220 F and pressures to 75 lb. Specifications, performance chart, dimensional drawings, and construction data are included. —K-70

Dielectric Materials

A report outlining the properties of silicones as dielectric materials is announced by Dow Corning Corp.

The brochure also discusses the use of silicone rubbers, fluids, resins, and compounds in applications ranging from electric motor insulation to intricate electronic control systems. —K-71

Gas Turbines

Two catalogs describing late developments in gas turbine design are available from Clark Bros. Co., one of the Dresser Industries.

The first, 28 pages, gives engineering and performance data on Mark TA model, a 1150-bhp gas turbine for industrial, refining and process applications.

The second, 6 pages, describes 302 and 305 gas turbines. These 8700–9300 bhp units, widely used to drive pumps, generators and centrifugal compressors, are also designed for drying or catalyst regeneration service. —K-72

Slitting Lines

A handbook published by Yoder Co., offers basic information on slitters and allied equipment.

First section of the 76-page illustrated handbook covers the design, selection, and operation of slitters and slitting lines. Time studies, analysis of operating cycles, methods of coil handling, scrap disposal and other operating data are included. Second part of the book contains specifications, capacity tables, and additional data on slitters, uncoilers, recoilers, coil cars, and scrap choppers. —K-73

Antifoams Bulletin

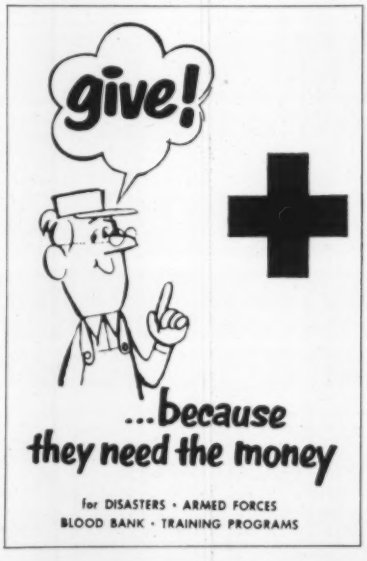
A new product bulletin describing antifoams, used to control foaming and carryover in steam boilers, has been released by Hagan Chemicals & Controls, Inc.

HSP-905, a four-page brochure, covers C-1, a light colored, water-soluble liquid, and HP, a dry brown powder. Seven case histories are included along with a chart depicting rates of carryover with and without antifoam treatment. Methods of feeding the dry and powder form materials are also discussed. —K-74

Air Conditioners

American Air Filter Co., has published a product bulletin describing the new line of AAF-Herman Nelson air conditioning units.

Bulletin No. 786 is 54 pages long and discusses special design features, standard accessories available, steps in selection of the basic unit and components, capacities, standard arrangements, dimensions, and suggested specifications. Nine pages are devoted to description of the components which make up the air conditioning unit. —K-75



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Four-Cycle Engines

Four-cycle V-type engines are described in a two-color, 18-page bulletin released by Nordberg Mfg. Co. Examples are shown of significant advancements in diesel engine performance for V-type engines that are supercharged, supercharged and intercooled, and Supairthermal. Operated on diesel, duafuel or spark-ignition gas the engines described are available in 12 or 16 cylinders with 13 or 13½ in. bore and 16½ in. stroke. Design and construction features are explained. Engine components are shown and described. **—K–76**

Water Control Valves

Nine different automatic water control valves and their uses are described in an eight-page bulletin released by Golden-Anderson Valve Specialty Co.

The line includes cushioned check valves, water level control valves, sensitive pressure regulators, and one-man control valves. Sizes range from 2 to 36 in., and the valves are manufactured for pressures up to 250 psi. Both angle and globe body patterns are available. The bulletin contains several photographs of installations and gives a description of the part played by cushioned swing check valves in the launching of guided missiles at Cape Canaveral. **—K–77**

Metallic Sealing Rings

Metal Products Div., Koppers Co., Inc., announces publication of an eight-page brochure on the performance and use of metallic sealing rings.

The brochure points out that use of these rings is rapidly increasing because they will withstand both high temperatures and high pressures and assure a minimum amount of leakage. Included are illustrations and definitions of the four major types of sealing rings as well as a discussion of the combinations of materials used. Drawings show typical applications. **—K–78**

Porous Metal Bearings

A brochure presents information on DU, United States Gasket company's new T.F.E. fluorocarbon resin, lead, porous bronze, steel composite in bearing applications.

The material has compressive strength up to 23 tons psi, wear resistance 10 to 100 times that of other self-lubricated bearings, low thermal expansion and high thermal conductivity, and operating temperature range from −328 to +536 F. **—K–79**

Stainless Tubing Steels

A technical data card, 148A, issued by Tubular Products Div., Babcock & Wilcox Co., covers hot working, annealing, welding and forming data on 24 of the widely-used austenitic and hardenable and nonhardenable ferritic stainless tubing steels. **—K–80**

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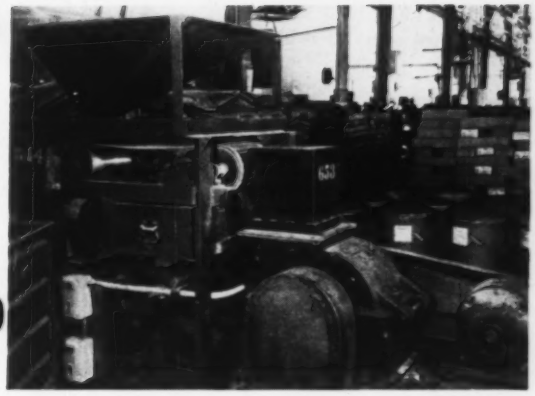

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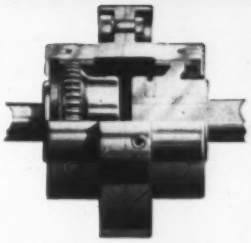

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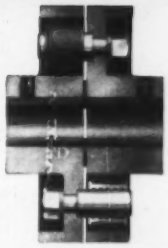

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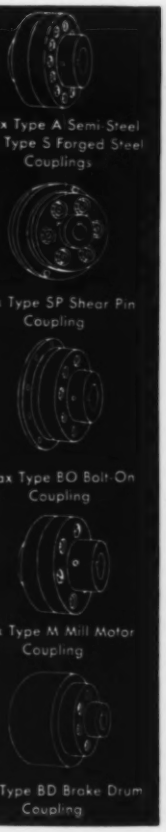

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Ajax Type SP Shear Pin Coupling
Ajax Type BO Bolt-On Coupling
Ajax Type M Mill Motor Coupling
Ajax Type BD Brake Drum Coupling

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Cycloidal Blowers

A bulletin covering its line of cycloidal blowers for vacuum service is announced by Roots-Connersville Blower, Div. of Dresser Industries, Inc.

The bulletin includes information on construction and technical data on capacities and ratings, many of which have been recently increased. A full-color cutaway view of the blower shows design features. **—K-81**

Water Treatment

An illustrated instruction folder describing its line of water treatment products for evaporative condensers, cooling tower systems, ice-making machines and chilled water systems is available from Calgon Co.

The brochure covers such products as Micromet plates, scale remover, powdered acid, Banox, algaecide, ice machine cleaners, ice machine treatment, corrosion inhibitor CS, gas leak detector, Instantreat and chemical feed pumps. It contains complete instructions on how to use these products, including charts showing recommended dosages for inhibiting scale, controlling corrosion, removing scale, and killing algae. **—K-82**

Liquid Level Gages

Jerguson Gage & Valve Co. has issued a two-page data sheet, No. 330, giving features, construction details and specifications on reflex and transparent welding pad gages.

The gages are made to weld right to the tank, vessel, or other liquid containing structure and thus become an integral part of it. **—K-83**

Self-Locking Clinch Nuts

An 18-page illustrated handbook, Design Manual 5803, reviewing available standard and miniature types of clinch nuts for the avionic, electronic, and electrical equipment industries, has been prepared by Elastic Stop Nut Corp. of America.

The manual includes a visual-descriptive index of all clinch nut types; a guide to selection of the correct fastener type; installation tips for best results in production; suggestions for installation tools and their effective use. Detailed standard drawings cover each part and give thread size, availability, temperature range, and part dimensions. **—K-84**

High Temperature Castings

A bulletin, No. 2537, on high temperature corrosion and abrasion resistant castings has been published by National Alloy Div., Blaw-Knox Co.

The bulletin describes the firm's production facilities and laboratory and illustrates typical castings produced. **—K-85**

Butterfly Valves

Features, advantages, dimensions, operators, and technical characteristics of rubber seated butterfly valves for both tight-closing and throttling applications are described in a bulletin issues by Builders-Providence, Inc., Div. of B-I-F Industries, Inc.

The bulletin is illustrated with application photographs, cutaway views, and a dimensional chart for all sizes. It includes a nomograph, which permits the user to read at a glance the valve size needed for this application, the pressure drop for each disk angle, the line velocity for a given flow rate and valve size. **—K-86**

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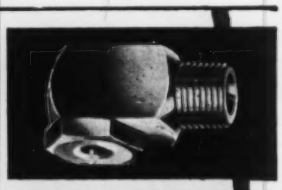
choice of over 12,000 basic designs



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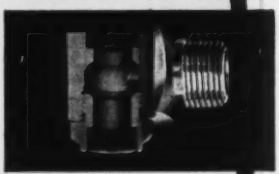

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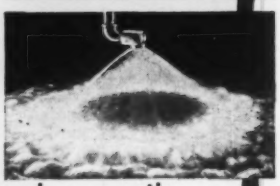

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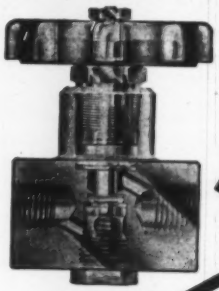
MANUAL SHUT-OFF VALVE
...for superior valve leakage control by Circle Seal



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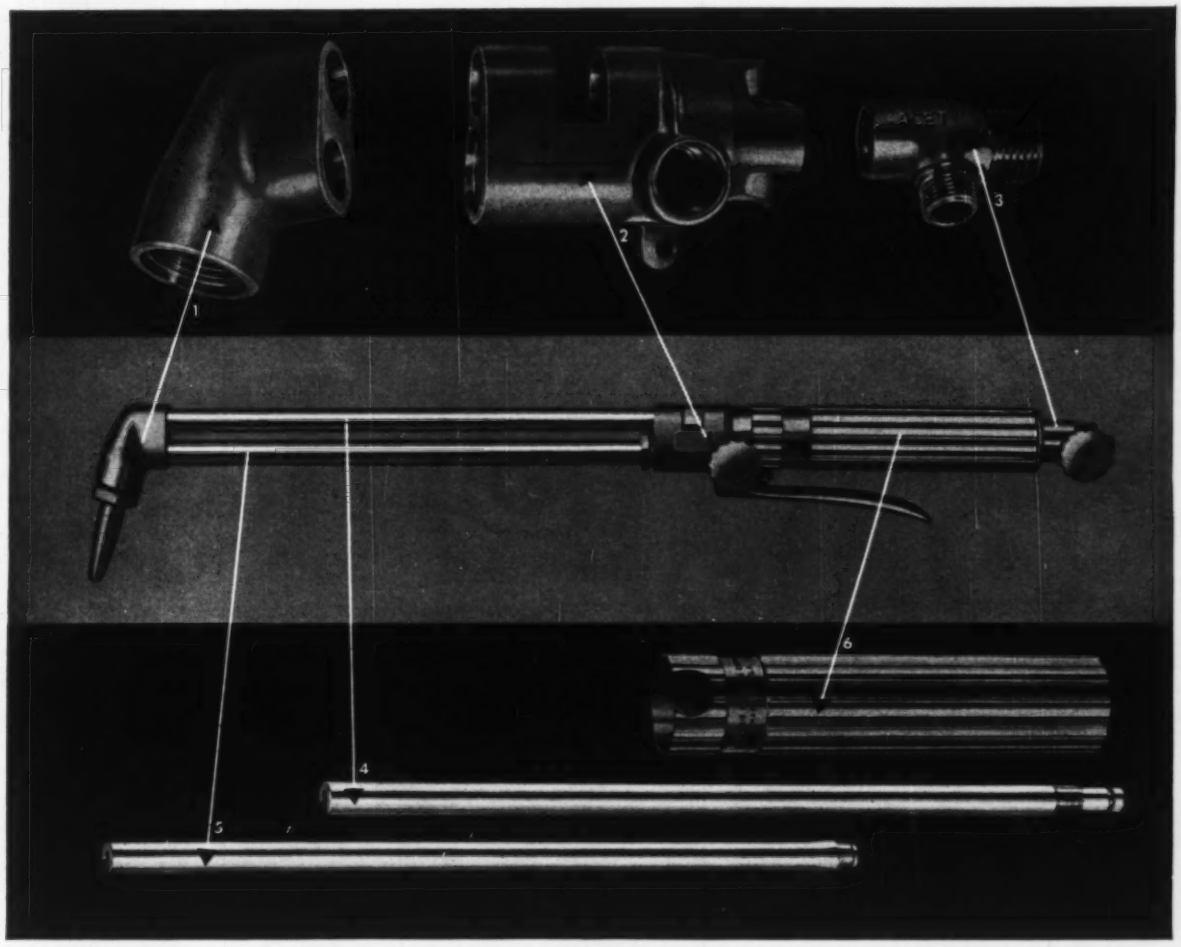
SHORT CUTS to finished products.

Anaconda pre-formed mill products cut time and cost in finishing and machining—reduce scrap losses.



Linde Company's "Purox" Cutting Blowpipe, Type "E," is produced more easily and economically with these Anaconda products. **1, 2, 3.** Die-pressed forgings, with these advantages: twice-wrought metal has denseness to prevent gas leaks; toughness and strength to stand up to abuse; has uniformity, dimensional accuracy to cut machining cost—finishing reduced to bright dip. **4, 5.** Thick-wall tubes of Ambrac-850 alloy to dissipate heat rapidly, prevent overheating and "flashback"; alloy has high strength for rough service, yet has sufficient machinability. **6.** Special-shape brass tube with fluting pre-formed is furnished in long lengths ready for fast, economical screw machine operation.

Cost-cutting possibilities are almost unlimited when imagination is applied to designing with pre-formed Anaconda mill products. Simplify costly built-up assemblies with die-pressed forgings. Cut machining and scrap with tubes and solid special shapes adapted to your needs. For imaginative and practical technical help, write: The American Brass Co., Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont. 5849

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EXTRUSIONS • FABRICATED METAL GOODS

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products made by
THE AMERICAN BRASS COMPANY

Extensively used in the rocket and missile industry—

Here are precision products for a precision industry ... Marsh products that are *fully approved* and widely used thoughout the aircraft and missile industry:

PRESSURE GAUGES

The Marsh "Mastergauge"

Accepted throughout industry as "the standard of accuracy," Marsh Gauges are the final solution to your most difficult and exacting problems. Recent Marsh developments are: Fusing of socket and bourdon tube into one-piece leak-proof unit by Marsh "Conoweld" process; "Marshalloy" case, lighter, stronger, more corrosion resistant; finer movements, safety cases, and many other unduplicated features. All Marsh Gauges are available with the Marsh "Recalibrator." There is a Marsh Gauge for practically every conceivable purpose—pressure, vacuum, compound.

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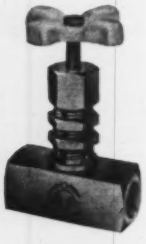

In the Marsh Needle Valve you have the answer to your need for a valve giving micrometer throttling and positive shut-off at *high* pressures—any pressure up to 10,000 psi—with equally precise regulation at any lower pressure. Today they are available in 416 stainless steel throughout with "Teflon" packing which is unimpaired by the most powerful solvents, acids and alkalies, even at temperatures up to 500° F. Suitable for oxygen, helium and high pressure air. Available in panel mounted pattern.

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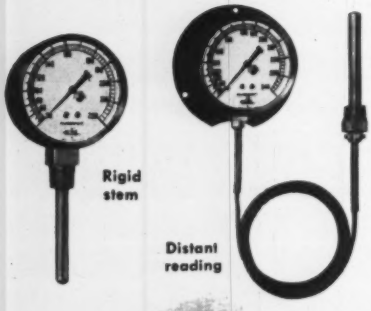

Rigid stem

Distant reading

The most versatile and accurate type of bourdon tube thermometer has been brought to its highest development in the broad, highly adaptable Marsh line. Accurate readings, even when the dial is located far from the point of measurement, is assured by the vapor tension principle. The Marsh line is a complete line—wide temperature ranges; many dial sizes; case patterns; finishes. All have the famous Marsh "Recalibrator"—handiest and best way to keep an instrument accurate.

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Ratio changes involve only the high or intermediate speed gear set. This set has splined bores and is easily mounted on precision-splined countershafts. Slip the original set off its shafts and mount the gear and pinion required for the new ratio. Fits are precise and an elastic stop nut locks the gear and pinion in place.

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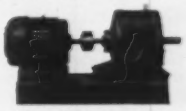
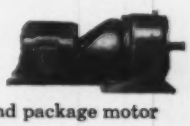
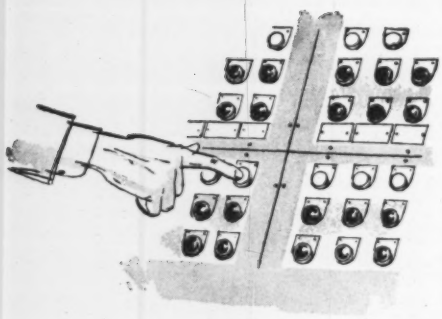


speed reducers . . . . . .

gearmotors . . . . . .



and package motor reducer drives . . . . . .



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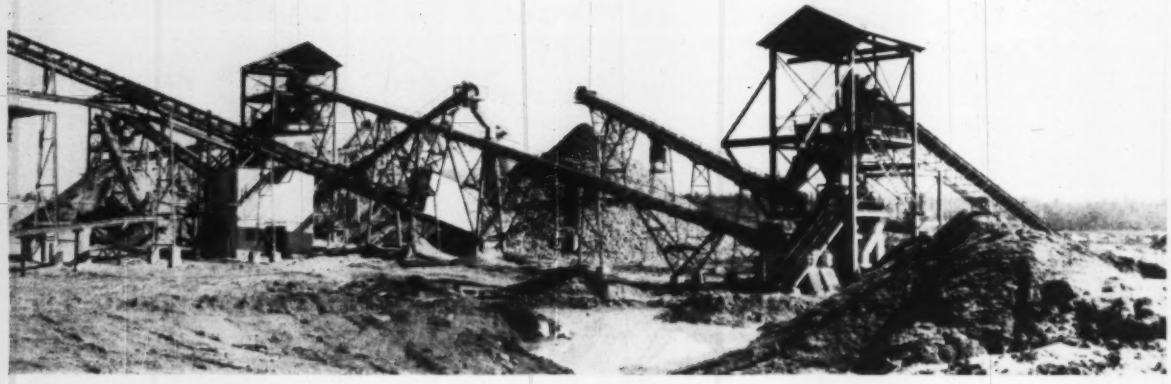
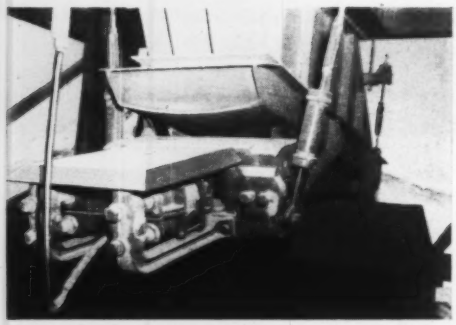
JEFFREY VIBRATING FEEDERS

...one man runs stone reclaiming operations, screening and washing plant, secondary crushers





Get details on how Jeffrey vibrating equipment and controls can simplify your materials handling job and save you money. Write for Catalog 930. The Jeffrey Manufacturing Company, 915 North Fourth Street, Columbus 16, Ohio.

THIS quarry produces both high calcium limestone and dolomite products. From a strictly operating standpoint, *one man at a Jeffrey-designed control panel* runs the screening and washing plant, two secondary crushers and reclaiming operations monitored by 15 Jeffrey vibrating feeders.

Jeffrey feeders under primary surge piles feed stone to the plant via reclaiming tunnel belt conveyor. Vibrating grizzlies with bars on 3" centers allow fine material to fall to belt conveyors ahead of coarser stone, insuring longer life for the belt.

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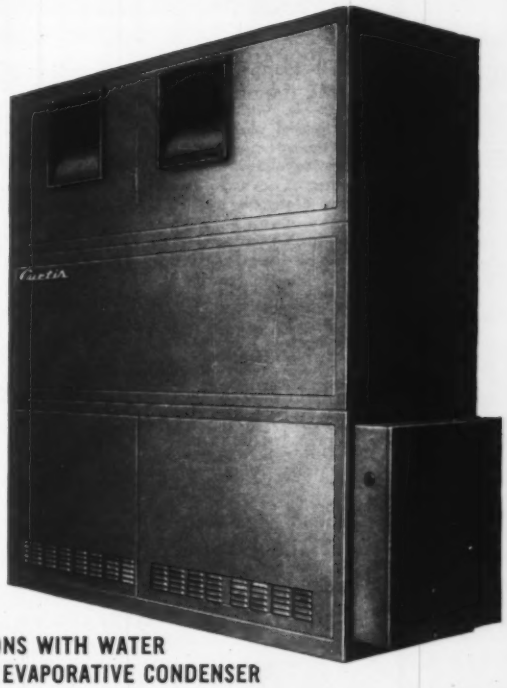
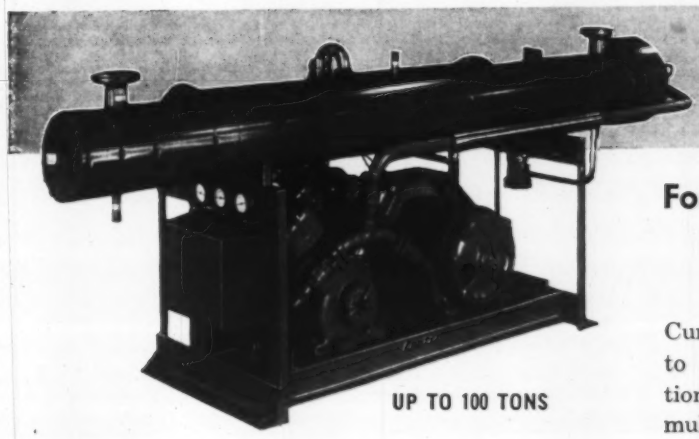


UP TO 50 TONS WITH WATER COOLED OR EVAPORATIVE CONDENSER



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For Air Conditioning Process Cooling Refrigeration

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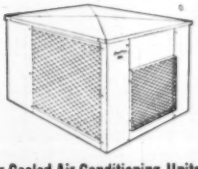
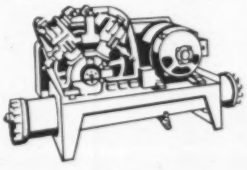
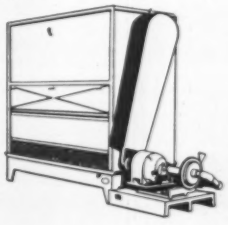


Air Cooled Air Conditioning Units, 3-5-7½ tons. Residential and commercial application.



Condensing Units up to 100 tons.



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Relieving pressure; relieving capacity at the relieving pressure; coefficient of discharge; opening, closing, seal-off, and start-to-leak pressures; blowdown; reproducibility of valve performance; and mechanical characteristics of valves as determined by seeing, feeling, or hearing.

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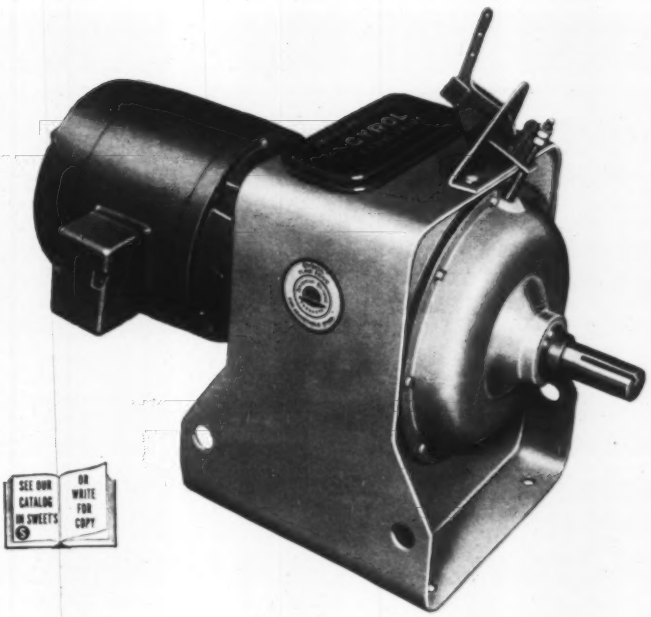

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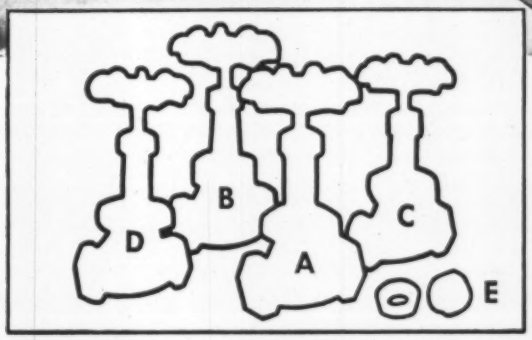

A — No. 225P . . . . . 350 WSP 550F, 1000 WOG
B — No. 260P . . . . . 300 WSP 550F, 600 WOG
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150 lb. 200 lb. 300 lb. 350 lb.

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from Donald W. Douglas, Jr.

President, Douglas Aircraft Company

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Douglas Aircraft Company, Box K-620
Santa Monica, California

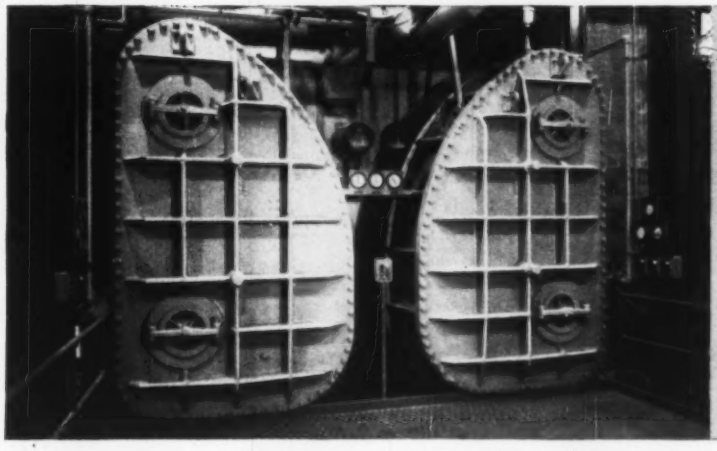
FIRST... The most powerful generator ever built soon will be served by a giant Yuba Surface Condenser which will have 200,000 sq. ft. of heat-transfer surface in a single shell. With a Yuba evaporator, this Yuba condenser will be in operation in Widows Creek Station #7 of the Tennessee Valley Authority. The history-making unit it will serve is a 500,000 KW General Electric reheat turbo-generator: 3600/1800 RPM, cross-compound, double-flow.

FIRST... At Arkansas Power and Light Company, an installation designed by Ebasco Services Inc. will have a 165,000 sq. ft. surface condenser designed and built by Yuba. With seven low and high-pressure feedwater heaters from Yuba, this condenser will serve a Westinghouse single-shaft, tandem-compound, quadruple-flow turbo-generator, the largest of its kind ever built.

Large as these condensers will be, they will also be distinguished by other Yuba characteristics. Their advanced design eliminates the need for excessive headroom. They will be easy to install, not only because of the minimum foundation work required but also because of the precision fit of the sections during re-assembly at the site. Furthermore, in operation, they are certain to show low oxygen content, high heat transfer, and a condensate temperature considerably above the temperature corresponding to saturation pressure.

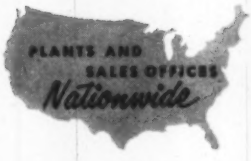
TWO MORE "FIRSTS" FOR YUBA POWER EQUIPMENT

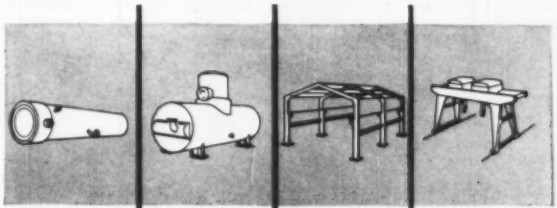
Yuba power equipment is engineered at Yuba Heat Transfer Division, Honesdale, Pennsylvania; manufactured in the East at the Honesdale plant, and in the West at Yuba Manufacturing Division, Benicia, California. For further information write or call Yuba Heat Transfer Divison, Honesdale, Pennsylvania.



◀ This Yuba Surface Condenser, the same type as those described above, is installed at the Valley Steam Plant, Los Angeles Department of Water and Power.

YUBA CONSOLIDATED INDUSTRIES, INC.





Feedwater Heaters | Evaporators | Structural Fabrication | Cranes

YUBA

YOUR FUTURE IS GREAT IN A GROWING AMERICA

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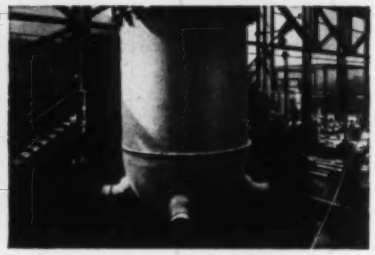
Electronics is one of our fastest growing industries. By 1965 there will be thousands of new needs and new jobs.



NUCLEAR ENERGY

Nuclear energy is now supplying power for ships and electric plants. Future possibilities are virtually unlimited.

HEALTH

Ever-increasing opportunities in research, development and production. In the field of antibiotics 50% more workers will be required.

CHEMICALS

Today there are more than 800,000 workers in chemicals and related industries. By 1970, there will be *twice* as many!

COMMUNICATIONS

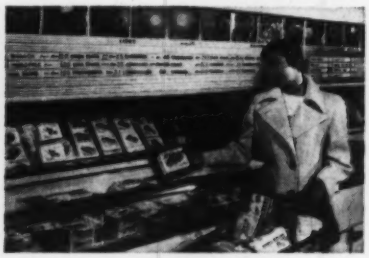
As our nation grows, the demands made upon communications grow proportionately. Thousands more needs, more jobs.

EDUCATION

The giant school-building program now beginning will offer new jobs to many thousands of construction workers.

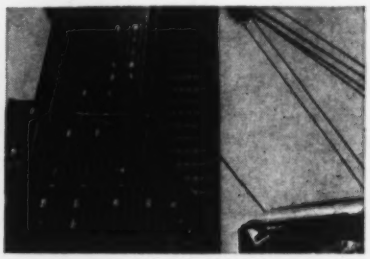
TRANSPORTATION

Our growing population demands constantly increasing mobility. Result: thousands of new opportunities, new jobs in the coming Jet Age.



FOODS

The trend is to labor-saving, ready-to-eat packaged foods. This new phase of an old industry will need thousands more workers.



CONSTRUCTION

3 million workers will benefit from new highway and construction programs—and even more workers will be needed soon.

7 BIG REASONS FOR CONFIDENCE IN AMERICA'S FUTURE

1. MORE PEOPLE—Four million babies yearly. U. S. population has *doubled* in last 50 years! And our prosperity curve has always followed our population curve.

2. MORE JOBS—Though employment in some areas has fallen off, there are *15 million* more jobs than in 1939—and there will be *22 million more* in 1975 than today.

3. MORE INCOME—Family income after taxes is at an all-time high of $5300—is expected to pass $7000 by 1975.

4. MORE PRODUCTION—U. S. production *doubles* every 20 years. We will require millions more people to make, sell and distribute our products.

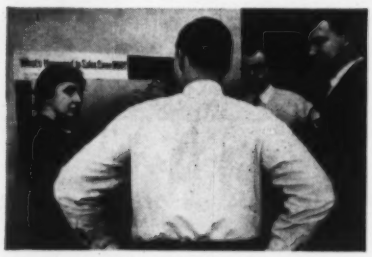
5. MORE SAVINGS—Individual savings are at highest level ever—*$340 billion*—a record amount that is now available for spending.

6. MORE RESEARCH—*$10 billion* spent each year will pay off in more jobs, better living, whole new industries.

7. MORE NEEDS—In the next few years we will need more than *$500 billion* worth of schools, highways, homes, durable equipment. Meeting these needs will create new opportunities for everyone.

* * *

Add them up and you have the makings of another big upswing. Wise planners, builders and buyers will act *now* to get ready for it.



MARKETING

Marketing includes sales, consumer research, product and package design, advertising and public relations. All need new skills every year—and *many thousands* of new workers!

FREE! Send for this new illustrated booklet, "Your Great Future in a Growing America." Drop a postcard to: ADVERTISING COUNCIL, Box 10, Midtown Station, New York 18, N.Y.

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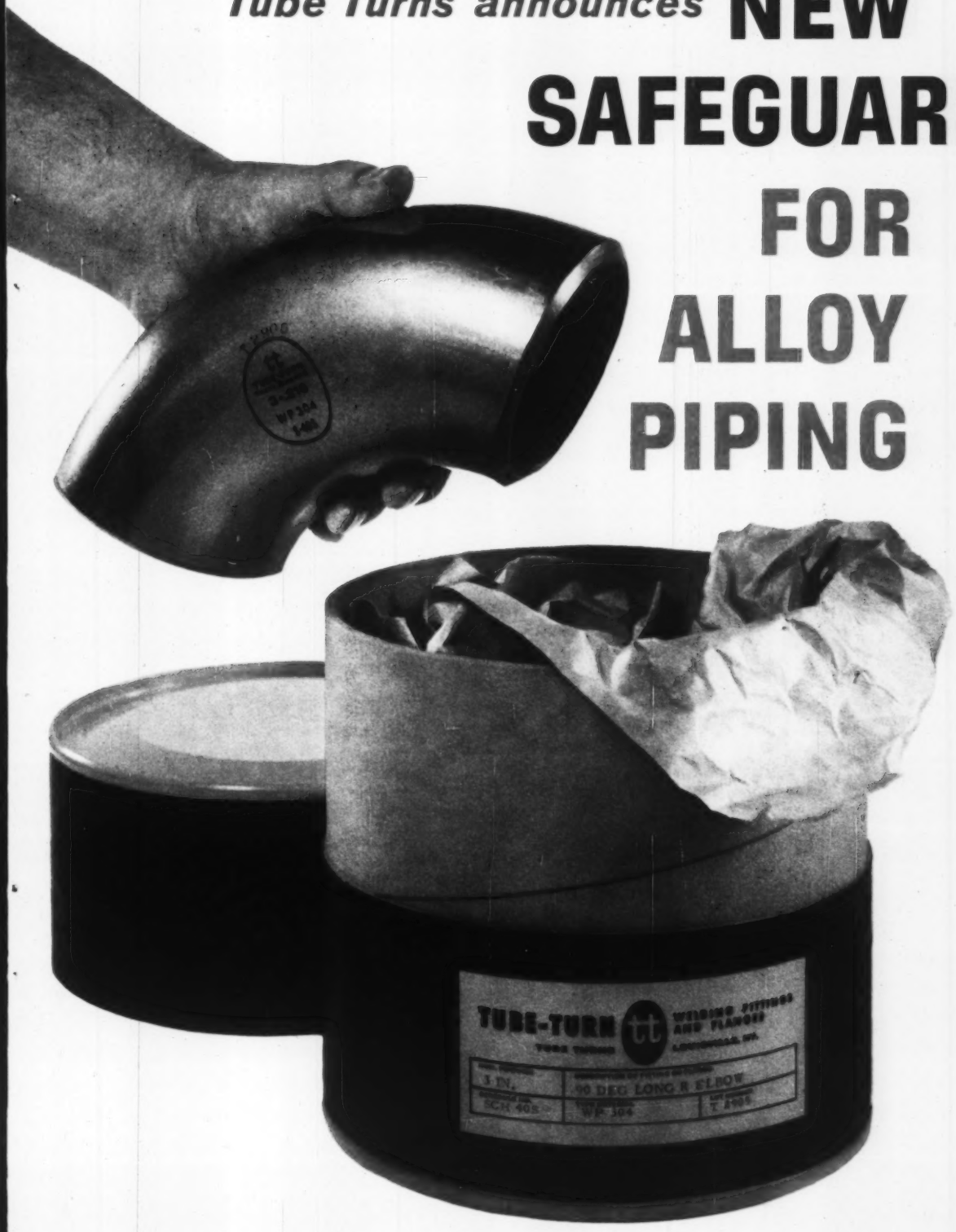
Tube Turns announces **NEW SAFEGUARD FOR ALLOY PIPING**



For details, turn the page... →

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Company Address _____
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Your nearby Tube Turns' Distributor can supply your fitting needs in alloys and non-ferrous metals . . . as well as in carbon steel, wrought iron, carbon-moly and chrome-moly. This one source for all your requirements in welding fittings and flanges enables you to simplify purchasing and cut red tape.

Tube Turns is now safeguarding the top quality of its stainless steel, aluminum and other alloy products with individual packaging. All of these fittings in sizes through 12", and flanges through 8", are now wrapped in kraft paper and individually packaged in a rugged container, built to standards established by extensive testing. Hence, from point of rigid inspection to job site, *each* fitting is *protected* against damage.

Here is new *convenience*, too. Your fittings are easier to store. And each container is fully marked with description of fitting or flange, size, schedule, type material and production lot for positive, easy identification in the warehouse or on the job.

Here is another plus value you get when you specify TUBE-TURN* Alloy Fittings and Flanges, and buy them from your nearby Tube Turns' Distributor.

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Degree essential. Experience as required.

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Shielding Analysis: Advanced studies and analysis on stationary and mobile plants.

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Stress Analysis: Structural, thermal, and dynamic stress analysis of high temperature reactor systems.

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Control Analysis: Reactor kinetics and overall nuclear power plant control – hazard analysis – analog and digital computers.

Operations: Foreign and domestic – for check-out, start-up and customer training. Includes operational analysis and design criteria.

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Instrumentation and Control: Senior physicists and EE's for design and development of advanced design transistor, vacuum tube, and/or magnetic amplifier control and instrumentation components.

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Senior opening. Degree required. Nuclear experience essential.

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Write for more details of exciting career opportunities at AI.
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(In the suburban San Fernando Valley, near Los Angeles)

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A DIVISION OF NORTH AMERICAN AVIATION, INC.
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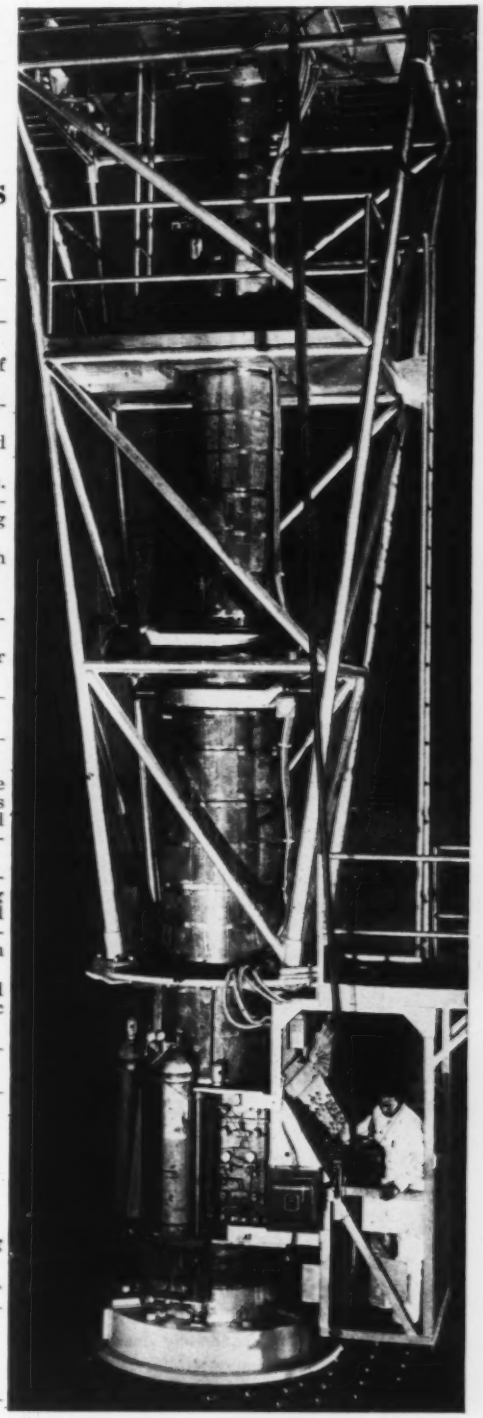

SRE Fuel Handling Cask. The Sodium Reactor Experiment and the Organic Moderated Reactor Experiment are both in successful operation. Plans for several central station plants based on these experimental power reactors are underway. AI is also conducting an advanced power reactor study for Southwest Atomic Energy Associates. Overseas, AI has already sold 5 reactors, and is affiliated with ASEA of Sweden and the new company INTERATOM (with DEMAG, West Germany).

NOTABLE ACHIEVEMENTS AT JPL...

THE ARMY'S NEW SERGEANT

JPL is proud to have the responsibility of designing and developing the U.S. Army's newest operational missile system—the Sergeant. This weapon is America's first truly "second generation" surface-to-surface tactical missile and, when placed in production will eventually succeed the Corporal which was also a JPL development.

The Sergeant, especially designed as an extremely mobile tactical weapon, utilizes a solid propellant rocket motor which provides better field handling and storage capabilities than those of many other weapon systems. It can deliver a nuclear blow deep into enemy territory and its highly accurate guidance system is invulnerable to any known means of enemy countermeasure.

All elements of the Sergeant are particularly designed for active field use with emphasis on reliability, mobility and the use of standard U.S. Army vehicles wherever possible. The erector-launcher, for example, is capable of rapid movement over rough terrain. These characteristics place in the hands of the U.S. Army an important new tactical element of extended range.

The basic activity at JPL continues to be—research into all scientific fields related to the development of weapons systems and space research vehicles.

CAREER OPPORTUNITIES NOW OPEN IN THESE FIELDS

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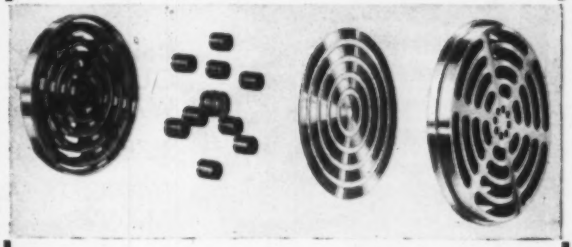

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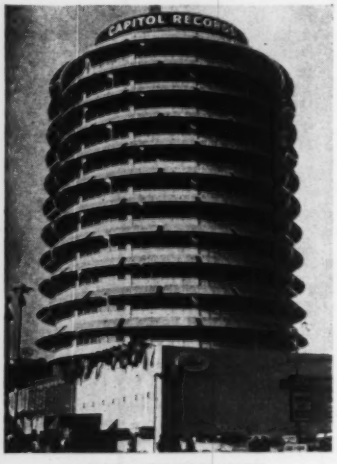

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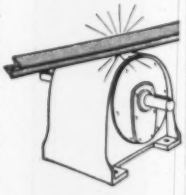

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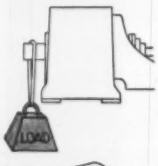

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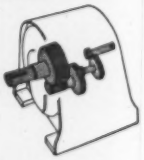

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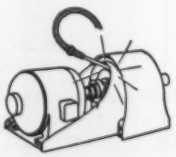

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AMERICAN-Standard
40 West 40 Street New York 18, N.Y.

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Page reserved for advertisements to experienced engineering specialists to fill immediate openings.

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1. are experienced and interested in the field of Experimental Stress Analysis,
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KAPL Metallurgist Richard L. Mehan taking a reading on a Zirconium alloy specimen being tested in a special strain-fatigue apparatus. Conceived, developed and built at KAPL, this new apparatus makes it possible to control and measure elastic and plastic strain developed in reactor materials under test. Conventional equipment controls only stress and strain within the elastic region.

MILESTONES IN REACTOR TECHNOLOGY

at The Knolls Atomic Power Laboratory

HIGHLIGHT OPPORTUNITIES FOR PROFESSIONAL CAREERS. Achievement of more efficient nuclear powerplants often hinges on knowledge of how reactor materials will behave under the highly specialized conditions to which they are exposed.

To obtain such information, KAPL Metallurgists and Engineers constantly explore new approaches to metallurgical problems in the nuclear field, often developing and using new equipment to get the answers they need. An example is the Strain-Fatigue Apparatus pictured above. SFA is providing KAPL Engineers and Scientists with valuable data on reactor-imposed conditions such as thermally-induced stresses and strains. Other areas of investigation include determining the effects of neutron bombardment and long-term creep on reactor materials. A milestone in reactor technology, SFA is the first apparatus used in AEC installations to study resistance to cyclical stresses imposed by large thermal gradients encountered in reactor operation.

Pioneering is a continuous process at the Knolls Atomic Power Laboratory, carried on by engineers and scientists from many disciplines. Two projects now under way include the twin Water-Pressurized Reactors for the Submarine *Triton* and a powerplant under development for the world's first atomic destroyer.

Professional opportunities exist today for Nuclear Engineers, Physical Scientists and Metallurgists who can contribute to the flow of creative achievement at KAPL. U.S. Citizenship required; advanced degree and/or related experience preferred. Inquiries regarding current openings are invited. Please send your resume in confidence to Mr. A. J. Scipione, Dept. 40-MT.

Richard L. Mehan is one of several metallurgists working on the development of new and more reliable reactor materials at KAPL. Dick Mehan joined General Electric after graduation from MIT in 1950 and came to KAPL in 1953, following two years of army service. He is also studying advanced metallurgy, evenings at Rensselaer Polytechnic Institute under G.E.'s advanced degree program.

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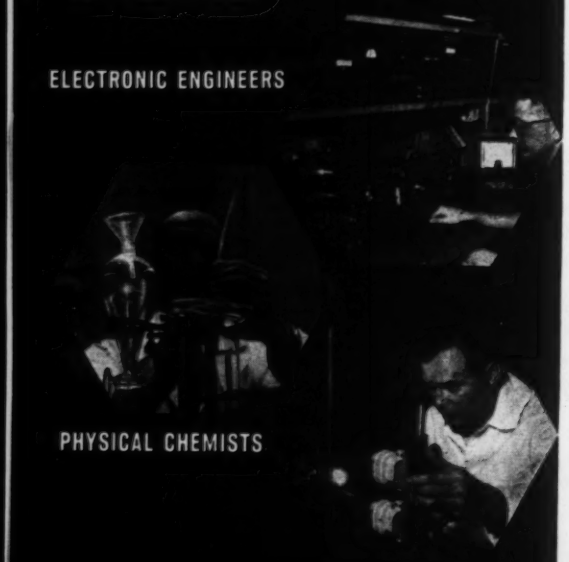

PHYSICAL CHEMISTS

SOLID STATE PHYSICISTS

ELECTRONIC ENGINEERS at TI are beating the semiconductor heat barrier with devices that will operate at 200 degrees centigrade and higher – twice the boiling point of water! Working closely with other scientists on the TI team, they continually explore new fields in electronics. Under the hot glare of infrared light which simulates extreme operating conditions, the engineer shown above is testing the newest TI silicon power transistor operating in conjunction with the totally new *Sensistor* temperature-sensing silicon resistor.

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Electronic and Electromechanical Apparatus – Radar, sonar, infrared, optics, navigation, magnetics, telemetering, communications, computers, transformers. Write R. E. Houston.

Research and Manufacturing – PhD level for research, development and applications: solid state device technology, ferromagnetics, infrared, microwave, magnetics, digital computers, radar, sonar, telemetering, etc. Engineers for production, planning, purchasing, cost analysis, etc. Write A. E. Prescott.

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"OPPORTUNITIES" 193-197

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ASSOCIATE and ASSISTANT PROFESSORS for fields of advanced dynamics, advanced strength, and elasticity. Also have opening for graduate student as half-time instructor. Engineering Mechanics Dept., Kansas University, Lawrence, Kansas.

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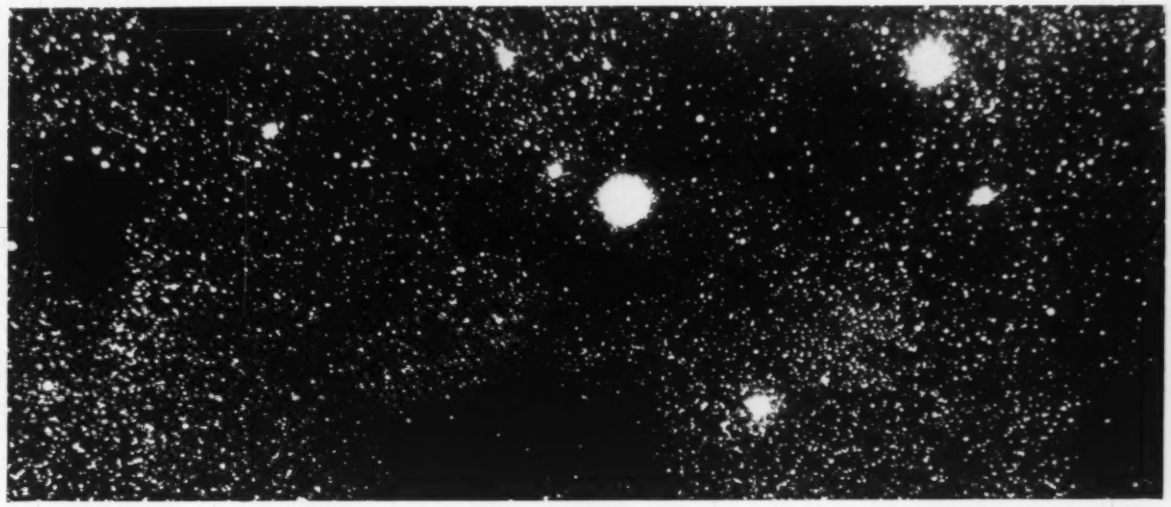

Courtesy Mount Wilson Observatory

FROM BEYOND THE SKY TO BENEATH THE SEAS

In the field of communications, two extraordinary events have occurred within a short span of time. One was the linking of Europe to America by the submarine telephone cable. The other was the sending of radio signals from U. S. satellites in outer space.

Both achievements depended on developments from Bell Telephone Laboratories. The cable was made possible by development of long-life electron tube amplifiers able to withstand crushing pressure on the ocean floor. The satellites derive their radio voices from transistors—products of basic research in semiconductor physics.

The deep sea amplifier and the transistor illustrate the wide range of work at Bell Telephone Laboratories. Here, over 3000 professional scientists and engineers explore and develop in physics, mathematics, electronics, chemistry, mechanical engineering, even biology—in every art and science which can help improve electrical communications.

Through this work, Bell Telephone Laboratories has helped make your telephone service the world's finest—and will keep it so.

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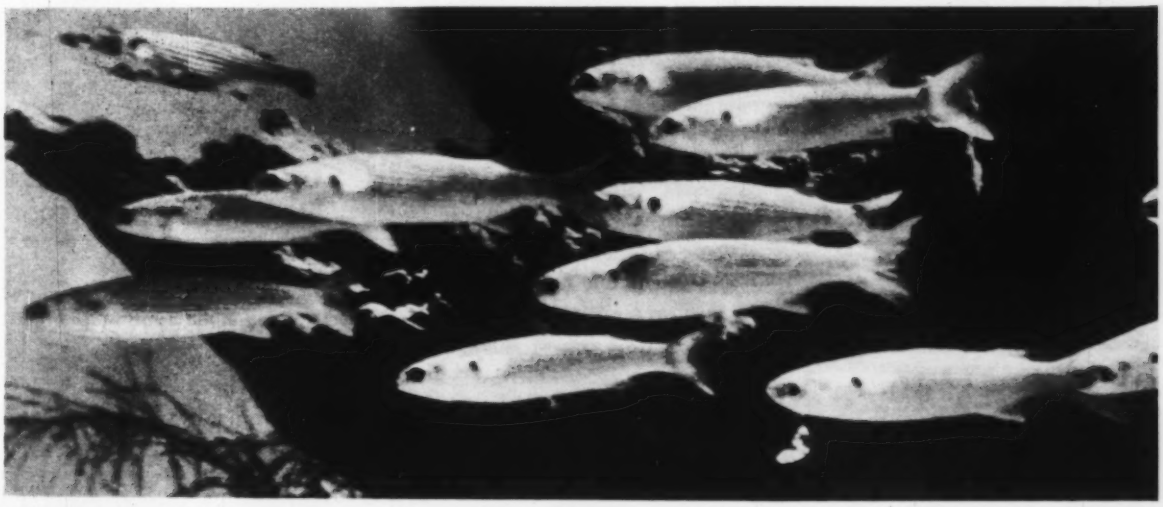

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Stephens-Adamson Mfg. Co.
Stewart-Warner Corp.
Alemite Div.
Streeter-Amet Co.
*Struthers Wells Corp.
Div. Titusville Iron Works
Sturtevant, P. A., Co.
*Syntron Co.

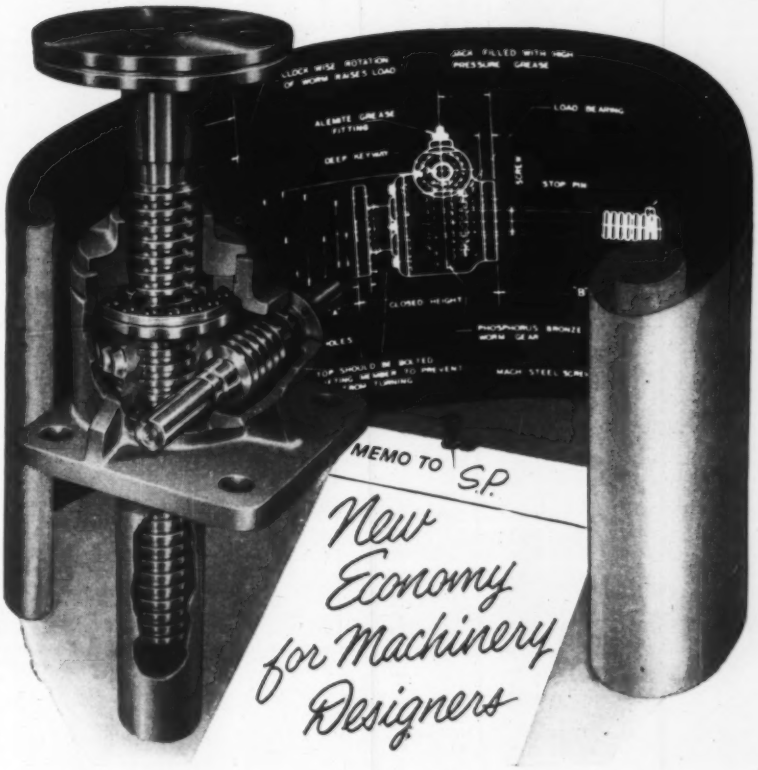
*Taylor Instrument Cos.
Technical Charts (Inc.)
*Titusville Iron Works
Div. of Struthers Wells Corp.

*Union Iron Works
Universal Drafting Machine Corp.
Universal Tube Corp.

Vickers (Inc.)
Div. Sperry Rand Corp.

Wabash Metal Products Co.
*Wheeler, C. H., Mfg. Co.
*Wickes Boiler Co.
Div. of Wickes Corp.
Wiegand, Edwin L., Co.
Wiley, John & Sons
Williams Gauge Co.
Wollensak Optical Co.
Worcester Valve Co.

*Zallea Brothers
Zonolite Co.
Z-Crete Div.



NOW, A STANDARD LINE OF DUFF-NORTON WORM GEAR JACKS

The economies of standardized production now can be realized by machinery designers who use Duff-Norton worm gear jacks for accurate positioning of loads weighing as much as several hundred tons. After 25 years of experience and hundreds of custom designs, Duff-Norton engineers have produced a standard line of eight jacks ranging from 2 to 100 tons in capacity which will meet almost any requirements. When jacks are used in an arrangement, added economy can be realized in raising unevenly distributed loads, since all models now have a uniform raise which permits jacks of varying capacities to operate in unison.

Worm gear jacks are purely mechanical devices, and they can hold heavy loads in position indefinitely without any creep. Functioning as components of machinery or equipment, they can raise or lower loads, apply pressure or resist impact. Worm gear jacks can be furnished with raises up to 24 inches, and they will provide exactly the same raise for years without adjustment.

Thousands of these jacks are in use on feeding tables, tube mills, welding positioners, pipe cut-off and threading machines, testing equipment, aircraft jigs, loading platforms, rolling mills, conveyor lines, and numerous other types of equipment. If you have a positioning problem, write for complete information, requesting Bulletin AD-66-FF, which includes drawings and full specifications.

DUFF-NORTON COMPANY

P. O. Box 1889 • Pittsburgh 30, Pennsylvania

COFFING HOIST DIVISION • Danville, Illinois

DUFF-NORTON JACKS
Ratchet, Screw,
Hydraulic, Worm Gear

DUFF-NORTON

COFFING HOISTS
Ratchet Lever
Spur Gear, Electric

NEW...

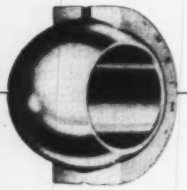
POWDER METALLURGY TECHNIQUE FOR PRODUCING Unibal®

2 PIECE SPHERICAL BEARING

A brand new innovation in spherical bearing design

Through a series of controlled thermal, physical-chemical, and mechanical steps, the balls are made of high density, through-hardened powdered iron alloy, and the outer members are made of sintered iron or sintered bronze with controlled porosity.

Pressing and sintering procedures make it possible to produce a bearing which will hold up to 20% of its own volume in oil. This means longer bearing life with less frequent relubrication required. Manufacturer's tests on a 5/16" bore bearing at 1350 rpm with a 30 lb. load ran for 2000 hours with only weekly relubrication.

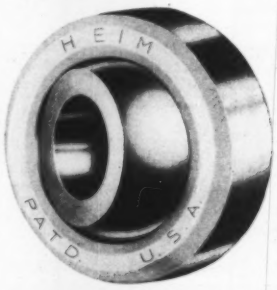


This cutaway view of the Unibal 2-piece spherical bearing shows how a coined (or swaged) type bearing presents a large surface-supporting area, and is capable of rotating so as to correct shaft misalignment in all directions.

Heim has been a leader in spherical bearings since their original development — an old hand with new ideas. This skill and experience can solve problems — and save money — on YOUR bearing requirements. Just call the nearest Heim bearing distributor or write direct for catalog or engineering assistance.

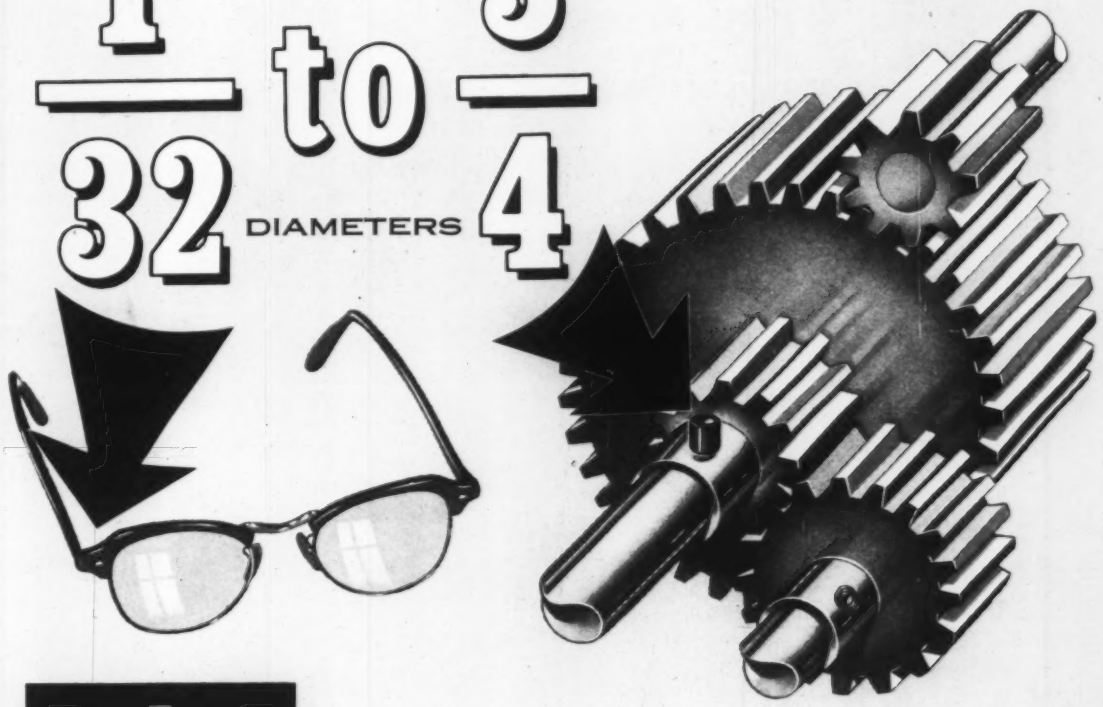
THE HEIM COMPANY
FAIRFIELD, CONNECTICUT

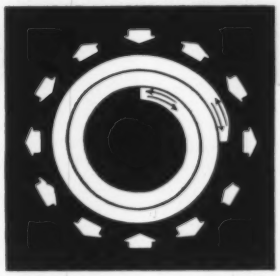
These new Unibal spherical bearings of sintered metal cost less than comparable bearings of conventional materials.



Like all Unibal spherical bearings and rod ends, the new 2-piece bearing produced by powder metallurgy, will correct misalignment to the maximum degree.

1/32" to 3/4" DIAMETERS





True spring coils give SPIROL pins extra strength in *all* sizes

Spiral coils make a true spring . . . give SPIROL pins full 360° radial tension when compressed in a hole . . . develop no critical stress concentration at any point. This spiral spring action increases pin strength . . . produces high shock-and-vibration resistance even in miniature sizes as small as 1/32" diameter. SPIROL pin's unique cross-section offers unequalled advantages in many applications: *Wider hole tolerances* — both plus and minus . . . *Non-heat-treated metals* — such as low-cost brass, copper, nickel, stainless steel, where anti-corrosion or conductivity are desired . . . *Three duties* — heavy, medium, light . . . *Greater shock resistance* — permits use of "medium duty" pins in most applications . . . *Cost reduction* — results from wider tolerances, easier insertion, reusable pins, simplified product design and servicing. No other type of pin — solid or flexible — offers all the qualities and benefits you get with SPIROL, the true spring pin.

FREE! *Write for complete literature on* SPIROL *spring pins, including price list.*

® **SPIROL** *the true spring* **PIN**

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Phone: PRescott 4-2411

3 new applications get longer life and minimum maintenance using Dodge pillow blocks with Timken® bearings

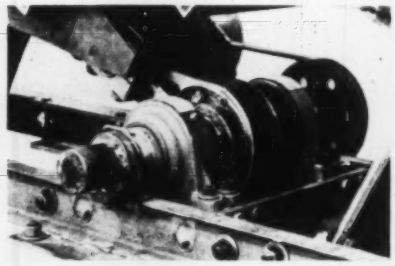
PICTURED below are three applications where Timken bearing equipped Dodge pillow blocks stay on the job with little attention under tough conditions. Their tapered design lets Timken® bearings take *both* radial and thrust loads in any combination. And full-line contact between rollers and races provides extra load-carrying capacity. Wear is reduced, maintenance is cut to the minimum.

Cutaway view shows the Dodge All-Steel pillow block with Timken bearing mounting. Of special design, the bearing has a tapered bore with self-aligning spherical outer surface —never needs adjustment.

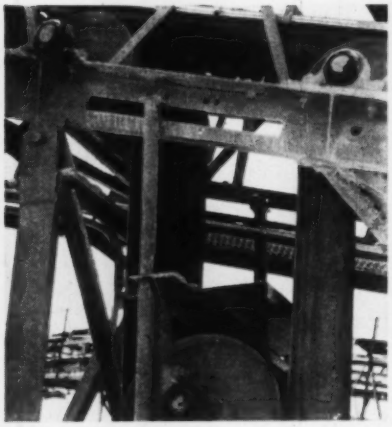
Besides the All-Steel pillow block, other versatile Dodge pillow blocks with Timken tapered roller bearings are: Type "E", Double-Interlock, Type "C" and Special Duty. All are compact in design. Special thrust devices that take up extra space are not needed.

And to get the finest steel for Timken bearings, we make it ourselves—America's only bearing manufacturer that does. So specify bearings trademarked "TIMKEN" for the machines you buy or build. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

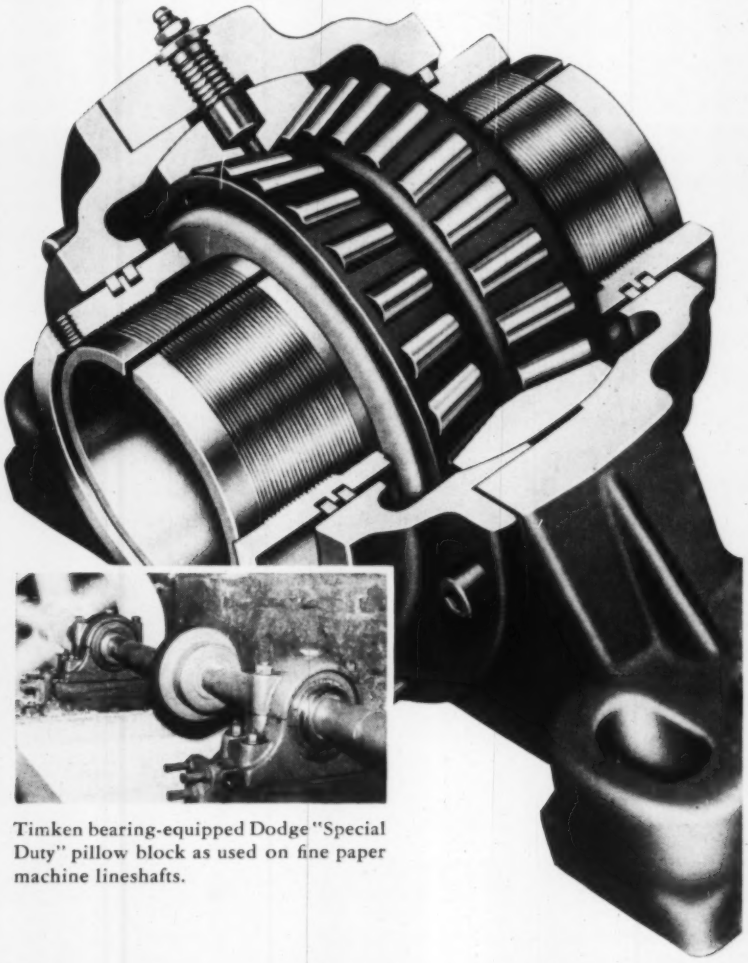
This symbol on a product means its bearings are the best.



Timken bearing-equipped Dodge All-Steel pillow block used in a vibrating conveyor.



Timken bearing-equipped Dodge Type "E" pillow block used in sand and gravel plant.



Timken bearing-equipped Dodge "Special Duty" pillow block as used on fine paper machine lineshafts.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS ROLL THE LOAD